ANALYSIS OF PRODUCTION PRACTICES AND DEMOGRAPHIC CHARACTERISTICS OF THE OHIO MAPLE SYRUP INDUSTRY

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the School of Natural Resources

By

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* * * * *

The Ohio State University 2005

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ABSTRACT

Analysis of Production Practices and Demographic Characteristics of
The Ohio Maple Syrup Industry

Ohio ranks as the fifth highest volume producer of maple syrup in the United
States, contributing on average $2.5 million to Ohio’s economy. Despite over 90
years of service by Ohio State University (OSU) Extension, little information is
available concerning the Ohio maple syrup industry. Initial surveys conducted at
OSU Extension maple syrup education programs revealed that 82% of attendees
relied on OSU Extension programs to stay current with maple production practices,
further justifying the need for information on production practices and producer
demographics. In 2004, a detailed survey was sent to all known Ohio maple syrup
producers with the goal of elucidating relationships among production factors and
demographic characteristics. Eighty-seven percent (n = 909) of the surveys were
returned, with 68% (n = 620) of the returns indicating they were active maple syrup
operations. Based on these surveys, the maple syrup industry in Ohio is best
characterized as a very traditional enterprise of small, second generation, family-
owned sugarbushes, that predominately utilize bucket collection systems. However,
there are important differences among demographic groups.
For example, chi-square analyses suggest that Amish producers in the state have significantly larger sugaring operations (> 250 taps), utilize bucket collection systems rather than more advanced tubing systems, and are younger than non-Amish producers ($P < 0.05$). Amish producers are also less likely to attend OSU Extension programming than their fellow non-Amish producers, while those older (> 53 years of age) non-Amish producers with large operations utilizing tubing collection systems were more likely to attend ($P < 0.05$). These relationships suggest that current OSU Extension programming is adequately serving non-Amish maple syrup producers; however, different approaches are likely needed to improve outreach and engagement of the underserved Amish maple syrup producers and the smaller ($< 250$ taps) non-Amish sugaring operations.
Dedicated to my Mother and to the rest of my family

and friends who encouraged and supported me through this trek.
ACKNOWLEDGMENTS

I wish to thank my advisor, Dr. P. Charles Goebel, for his intellectual support and guidance and for his encouragement and enthusiasm to allow me to travel the directions taken. His understanding, insight, and patience were the foundation within the building process. His willingness to go above and beyond to mentor, coach, assist me are mere reflections of his outstanding qualities as a man, a father, a husband, a scholar, and advisor. I thank Dr. Randall Heiligmann for his mentoring, coaching, frankness, technical assistance and his friendship. His personal interest, involvement, and guidance in development of my OSU Extension career continues to be immeasurable in value. I am grateful to Dr. Matthew Bumgardner for his advice and technical support throughout the development and implementation of the research. I thank Dr. Nikki Conklin for being one of the nicest people I know. Her friendship throughout my years with Ohio State University Extension has been a pure blessing; I cherish her strength and friendship. To Dr. Richard Moore, thank you for the assistance—you always knew the answers to the questions that stumped me. I also wish to thank Gary Bays the professor in my first college class who became a friend. Thank you for the encouragement, talent, and the laughs and for always believing in me. You were the first professor and one of the best I ever had the privilege to learn from. I am thankful to Dr. Bert Bishop for his assistance throughout the analysis and interpretation of the data. Making sense of the massive amount of data was a large task. To Henry Marckres, thank you for the technical support. Your assistance, insight and friendship were invaluable throughout this process.
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I want to thank the Administration of Ohio State University Extension for allowing me the privilege to pursue the degree which would have been an impossible dream without their blessing and support. To my co-workers at the Extension Center at Wooster, thank you for assisting where you could and for helping to process the large volumes of mail.

I finally must thank the Ohio maple syrup industry, the equipment dealers and producers who have assisted me and participated in the process over the two year project. Without their willingness to open up and reply to the research requests, work like this is not possible, and it’s a testament to the good people of Ohio.

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PUBLICATIONS

Extension Publications


FIELDS OF STUDY

Major Field: Natural Resources
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CHAPTER 1

The Maple Syrup Industry in Ohio

INTRODUCTION

The spring ritual of producing maple syrup from the sap of the sugar maple (Acer saccharum Marsh.), as well as black maple (Acer nigrum Michx. f.), red maple (Acer rubrum L.), and silver maple (Acer saccharinum L.) has been a traditional source of sugar and a supplemental income to many Ohio families. The sugaring process was first described in the 1500s by French explorers. The native Indian tribes they encountered, in what are today the New England states of Maine, New Hampshire and Vermont and the Province of Quebec Canada, indicated that making sugar had been a long-standing cultural practice. Ohio's first written record of maple sugaring came from a frontiersmen son, James Smith, in 1756 when held prisoner in the Ohio Valley by the Caughnawagas Indians (Lawrence, Martin, and Boisvert 1993). As sugar from sugar cane was extremely expensive in the 1700 and 1800s, maple sugar was a highly sought after commodity by many early settlers. Thomas Jefferson in 1791 even declared that every citizen should have a maple orchard or sugarbush to produce sugar and reduce reliance on foreign made sugar (Lawrence, Martin, and Boisvert 1993).
In 2003, Ohio produced 4% of the United States maple crop and 0.6% of the total North American maple crop (USDA-NASS 2004). Ohio maple production is small-scale when compared to Vermont, Maine and New York which produced 73% of the United States maple crop or compared to the Province of Quebec, Canada, which produced 79% of the total North American maple crop in 2003 (USDA-NASS 2004). In the first census of agricultural products (1840), Ohio recorded producing 6.3 million pounds of sugar (United States Census 1840). By the 1870 census, Ohio continued to lead the nation by producing 38% of the nation’s total crop of 921,057 gallons of syrup (United States Census 1870). Today, Ohio ranks on average as the fifth largest producing state even though it is located on the southern boundary of the North American maple producing region (USDA-NASS 1992-2004). In 2003, maple syrup production contributed $1.8 million to Ohio’s economy, $35.6 million to the United States economy, and $114.5 million to the Canadian economy (USDA-NASS 2004).

EDUCATIONAL AND RESEARCH ENTITIES

The Ohio State University Extension system (OSU Extension) has played an active role for over 90 years by developing researched-based knowledge provided through educational workshops, programming, and written materials targeted for maple producers. Genetic research on sugar maples conducted by faculty at Ohio Agricultural Research and Development Center (OARDC) produced genetically
superior maple trees that have on average higher sugar content than sugar maple
trees in the typical sugarbush stand (Kriebel 1960; Kriebel 1961; Kriebel 1990;
Heiligmann et al. 1996; Graham 2003)

Despite being the fifth largest maple producing state in the U.S. and being a
major client of OSU Extension, little is known about the Ohio maple industry or the
people who produce the maple sugar and syrup. The tradition of sugaring has
changed little since Ohio’s settlement; however, the process and methods have
changed tremendously over the last 150 years. This is especially true over the last
30 years with technological advances that have improved sugar content, maple
syrup quality, and production efficiency for what traditionally has been a very labor-
intensive industry.

RESEARCH OBJECTIVES

The objectives of this study were to better understand the characteristics of,
and influences on, the maple syrup industry in Ohio, including the methods of
production, the characteristics of producers and consumers, and the methods by
which OSU Extension and other organizations can serve the maple syrup industry.
Previous surveys conducted by the United States Department of Agriculture (USDA),
Ohio Department of Agriculture (ODA), OARDC, and OSU Extension have examined
production volumes and certain characteristics of the industry (e.g., economics of
sugaring, percent sugar content, and feasibility and interests of producers in
starting a state maple producer association). However, there has never been an in-depth assessment of industry practices and procedures or of the demographic components of Ohio’s maple syrup industry.

In Chapter 2, I address the influence and impact that OSU Extension has had on Ohio maple producers through a survey administered at the annual, three-day maple syrup production workshops conducted by OSU Extension known as the “Ohio Maple Days” (OMD). Specifically, I: 1) review the advancements in sugarbush and sugarhouse management being implemented in many family-owned maple syrup operations in Ohio; and 2) better understand how maple producer educational programs have influenced the production of maple syrup as one of Ohio’s primary family-owned forest enterprises.

In Chapter 3, I utilize a state-wide survey of known maple producers conducted from May-August 2004 to better understand the characteristics of the Ohio maple syrup industry and the demographics of producers and consumers across the state. The objectives of this survey were as follows: 1) to identify current maple syrup production practices and methods used; 2) to identify characteristics of sugarbush management practices and the equipment used to produce syrup; 3) to identify the characteristics of the producers of maple syrup in Ohio; and 4) to identify the sources of information used and the issues facing maple producers today and in the future. All of these efforts will help OSU Extension in providing the latest research-based educational materials and programming to this important forest industry.
Finally, in Chapter 4, I examine the influence of important demographic characteristics (producer age, producer heritage, participation in Ohio Maple Days programming) and production factors (sap collection methods, and size of the sugaring operation) on the maple industry in Ohio. Specifically, I: 1) examine the relationships among producer age, sap collection method used, cultural heritage of the producer, and producer participation in the Ohio Maple Days; 2) determine how these characteristics influence the sugaring operation size (number of taps); and 3) discuss the implications these results have on the maple industry in Ohio and how these results can guide OSU Extension educational programming and materials.
LITERATURE CITED


CHAPTER 2

The Role of Ohio State University Extension in Supporting Maple Syrup Production in Family-Owned Sugarbushes of Ohio

ABSTRACT

The maple syrup industry in Ohio, which ranks fifth in total production in the United States, is comprised primarily of small family-owned operations that are served by The Ohio State University Extension (OSU Extension) system. We evaluated the effectiveness of OSU Extension educational programming designed to improve sugarbush management through a survey administered at the three 2004 Ohio Maple Days workshops. Most survey respondents indicated that after attending past maple syrup workshops they implemented changes that were relatively simple and inexpensive; however, most indicated they are interested in learning more about technologies that increase production and maple syrup quality.
INTRODUCTION

Maple syrup production is a sustainable family forestry activity that has a long tradition in North America. Maple syrup was an integral part of many Native American communities, used as the primary sweetener in the Native American diet (Wittstock and Kakak 1993). Sap was collected in the spring and boiled down to make syrup or sugar using equipment, such as clay pots, and open fires, which often remained at the site year round. In many Native American cultures, the rights to these “sugarbushes” were hereditary, passed down from generation to generation. With the arrival of Europeans in the 16th and 17th centuries, maple syrup production in many areas increased providing a cheap and high quality source of sugar as the tariffs and expense of cane sugar imported from the West Indies made it an unaffordable luxury (Lawrence, Martin, and Boisvert 1993; Lockhart 2000).

In many ways, the methods used by early European settlers to produce maple syrup have not changed dramatically over the past 400 years. The major refinements in the process of producing maple syrup have been associated with collection and evaporation technologies (Huyler 1982; Walters 1982; Koelling and Heiligmann 1996), although there has been considerable research on the factors affecting the sap sugar concentration (e.g., Stevenson and Bartoo 1940; Moore, Anderson, and Baker 1951; Morrow 1955; Taylor 1956; Kriebel 1961; Larsson 1967), tree physiology and sap chemistry (see extensive work by
(Heiligmann 1987; Koelling and Heiligmann 1996; Morselli and Whalen 1996), the economics of maple product production (e.g., Kearl 1970; Huyler and Garrett 1979; Huyler 1982; Sendak and Bennink 1985; Huyler and Williams 1992 and 1994) and the genetic improvement of sugar maple for higher sap sugar content (Kriebel 1960; Kriebel 1989; Kriebel 1990).

THE MAPLE SYRUP INDUSTRY IN OHIO

At the turn of the 19th century, Ohio was the largest producer of maple syrup (924,000 gallons annually), the third largest producer of maple sugar (614,000 pounds annually), and the largest producer of total maple products (equivalent of over a million gallons annually) in the United States (United States Census 1840; United States Census 1870; Bryan, Hubbard, and Bitting 1912). Additionally, many maple syrup equipment industries were based in northern Ohio. Today, on average, Ohio ranks fifth among states in syrup production for the past ten years, occupying a position ranging from fourth to eighth in any given year (Table 2.1). In 2003, maple syrup production in the United States totaled 1.24 million gallons, down 11% from 10-year average, with Ohio contributing 75,000 gallons, down 15.7% from 10-year average, (USDA-NASS 2003).
Ohio’s decline in maple production since 1840 is in response to several factors. One of the most important has been the dramatic shift in forest cover. In the mid 1800s, Vermont and much of the northeastern United States was only 20% forested due to timber harvesting and land clearing (Vermont Agency of Natural Resources 2005); however, Vermont is currently dominated by forest cover (87%) with sugar maple being the dominant species. Ohio has essentially experienced the opposite trend. In 1840 at the time of the first census of agricultural products, Ohio was 93% forested (Ohio Forestry Association 2003). Ohio’s forest cover declined to around 10% by 1900 and has since recovered to approximately 30% today (Ohio Forestry Association 2003).

In addition to the dramatic shift in the maple resource, there have been other important factors responsible for the decline in Ohio’s maple production. During the late 1800s the status of maple sugar was transformed from a staple sweetener to a luxury item as cheaper cane sugar was readily available in the American market. Another reason for the decline is the differing roles taken by the

<table>
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<th>State</th>
<th>Average Production (gallons)</th>
<th>Average Taps (1,000)</th>
<th>Average Yield Per Tap (gallons)</th>
<th>Average Price (per gallon)</th>
<th>Average Value of Crop to state’s Economy</th>
</tr>
</thead>
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<tr>
<td>Vermont</td>
<td>502,000</td>
<td>2117</td>
<td>0.189</td>
<td>$29.79</td>
<td>$12,311,200</td>
</tr>
<tr>
<td>New York</td>
<td>274,000</td>
<td>1306</td>
<td>0.169</td>
<td>$27.97</td>
<td>$6,941,100</td>
</tr>
<tr>
<td>Maine</td>
<td>197,500</td>
<td>1088</td>
<td>0.213</td>
<td>$19.68</td>
<td>$1,551,400</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>107,800</td>
<td>425</td>
<td>0.175</td>
<td>$26.55</td>
<td>$2,369,200</td>
</tr>
<tr>
<td>Ohio</td>
<td>89,000</td>
<td>398</td>
<td>0.184</td>
<td>$33.04</td>
<td>$2,528,900</td>
</tr>
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Table 2.1: Average maple syrup production values from top five producing states from 1992-2002.
various state and governmental agencies. While the Ohio Department of Agriculture has not been actively involved in promoting or regulating Ohio’s maple syrup industry, the Vermont Department of Agricultural has taken a very active role in promoting and maintaining Vermont’s maple industry. This top-down government support in conjunction with very proactive independent producer organizations (e.g., Vermont Sugar Makers Association, Vermont Maple Syrup Promotional Board) has resulted in increased market share across the United States, especially in many upscale markets of the northeastern United States. When contrasted with the Ohio Maple Producers Association which does very little to promote Ohio maple syrup, or OSU Extension which historically has focused on providing educational support to increase production practices but not marketing strategies, it is not difficult to understand how Ohio’s maple production has declined over the past 150 years.

Ninety percent of Ohio’s maple syrup operations are family-owned and operated, with the business typically passing from one generation to the next. Although only three producers list maple syrup as their full-time occupation, sugaring remains an important activity that provides supplemental income to many agricultural and rural families (see Chapter 3). While the monetary value from the sales of Ohio maple syrup and other products is small when compared to the row crop or animal husbandry industries, income from maple syrup sales plays a vital role in contributing to the quality of life and economic well-being of Ohio maple producers.
The Ohio State University Extension (OSU Extension) system has the primary role of providing education and research programming for maple syrup producers across the state. For over 90 years OSU Extension has used a variety of methods to provide producers the latest in research-based information and training that has enabled them to make effective decisions and implement appropriate new technologies and research to increase their productivity and profitability. Integral to this effort has been a series of annual workshops called Ohio Maple Days. These one-day workshops are held across the state every January and are attended by maple syrup producers from Ohio and surrounding states, including residents of Pennsylvania, New York, West Virginia, Indiana, and Michigan.

In an effort to learn more about where these part-time family-operated forest industries obtain information on sugarbush and sugarhouse management and the impact of OSU Extension on these operations, we conducted a survey of the participants attending the three one-day Ohio Maple Days workshops in 2004. The objectives of this paper are to: 1) review the advancements in sugarbush and sugarhouse management being implemented in many family-owned maple syrup operations in Ohio; and 2) better understand how maple producer educational programs have influenced the production of maple syrup as one of Ohio’s primary family-owned forest enterprises.
The Sugarbush

The heart of any sugaring operation is the sugarbush – the stand of maples (usually sugar maple *(Acer saccharum* Marsh.), as well as black maple *(Acer nigrum* Michx. f.), red maple *(Acer rubrum* L.), and silver maple *(Acer saccharinum* L.)) that are tapped and from which sap is collected. The majority of the sugarbushes across Ohio are located in second-growth or third-growth forest stands; however, there are a handful of orchard-type plantations. The average Ohio sugarbush is 27 acres with a range of 0.25 acres to 190 acres. Within the traditional sap collection method of buckets, the average size operation has 417 taps with a range of 4 to 5,000. Within the more modern tubing collection systems, the average size operation has 720 taps with a range of 12 to 6,500 taps (see Chapter 3).

Most maple syrup producers must consider the expense in adopting technology and practices that improve profitability and sugarbush health (Figure 2.1). Sap collection in galvanized metal buckets is the traditional method that is traced back to the use of tin during the civil war in the mid 1800s. Before metal containers sap collection in wooden troths from hollowed-out logs and wooden buckets were the standards (Lawrence, Martin, and Boisvert 1993). More recently developed tubing systems with vacuum have been shown to dramatically increase profitability – they require less capital expense, they increase production per tap, and they require less labor than a bucket or bag operation (Huyler 1982; Walters 1982; Heiligmann et al. 1996). Additionally, the use of tubing contributes to sugarbush health by reducing or eliminating the movement of heavy equipment.
(collecting equipment) in the sugarbush during spring, when soils are usually wet and vulnerable to compaction. Ohio maple producers have been slow to evolve into modern sap tubing collecting systems in that 62% of all taps are found in bucket collection operations and the bucket operations make up 78% of all sugaring operations in Ohio. (Chapter 3 will further detail the descriptive issues of Ohio’s industry while Chapter 4 will investigate the associations between five different variables (heritage, age, sap collection method, attendance to the Ohio Maple Days, and operation size) and maple production.)

<table>
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<tr>
<th>Tap Size</th>
<th>traditional taps used a 7/16” hole; the new health spout uses a 5/16” hole that allows even older trees to heal faster after the spout is removed ($0.30 to $1.50 ea.)</th>
</tr>
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<td>Tubing</td>
<td>a semi-ridge ploy plastic that transfers sap from the tap to a collection tank replacing buckets and plastic bag containers; reduces labor costs with collection and requires fewer entries in the sugarbush during the spring ($0.08 to 0.10 per foot).</td>
</tr>
<tr>
<td>Conservative Tapping Guidelines</td>
<td>trees with a diameter of 12-18 inches use 1 tap, trees greater than 18 inches can handle 2 taps rather than traditional guidelines that allows for up to four taps on large maples (trees with circumference &gt; 78 in).</td>
</tr>
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<td>Tapping Tools</td>
<td>use of commercial tree tapping bits create a clean-cut hole that promotes faster closer after tap is removed ($15 to $20).</td>
</tr>
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<td>Sap Ladders</td>
<td>a tubing matrix allowing producers the ability to pull sap up from areas of lower elevation ($20).</td>
</tr>
<tr>
<td>Super Sweet Trees</td>
<td>genetically improved sugar maple trees that have higher sap sugar contents, ranging between 3 and 6 percent.</td>
</tr>
<tr>
<td>Vacuum &amp; Release</td>
<td>system used to pull sap in tubing systems into holding areas; allows for the extending of tubing further into woods and increasing sap flow ($700 to $1,900).</td>
</tr>
</tbody>
</table>

Figure 2.1: Some recommended sugarbush equipment & practices that have been discussed at recent Ohio Maple Days workshops.
While many maple syrup producers in the past used the sugarbush as pasture or shelter for cattle, sheep, and hogs, livestock is rarely seen in today’s sugarbush. Many producers are focused on evaluating sugarbush and tree health looking for crown dieback, evidence of forest pests, soil compaction, and tree wounds, and then modifying their practices to address the problems. Producers are tapping more conservatively than their fathers or grandfathers, waiting until the trees are at least 12 inches in diameter before tapping, using fewer taps per tree, and adopting smaller diameter spouts (5/16” instead of 7/16”) that produce tap holes that heal more quickly.

Many maple producers are also adopting silvicultural practices to improve the health and productivity of their sugarbush. Producers are using thinning or improvement cuts to encourage the development of healthier trees with larger, deeper crowns, resulting in a greater volume of sweeter sap (Morrow 1955; Larsson 1967; Heiligmann and Staats 1996). Sap sugar content is tested and used as a criterion for selecting trees for release, along with more traditional criteria including tree location, crown size, crown class, and tree vigor. In an average year Ohio sugar maple sap will average about two percent sugar. Individual trees within stands, however, often have sugar contents well in excess of three and even four or more percent. Increasing the average sap sugar content from a sugarbush by releasing trees with high sap sugar to develop large, deep crowns translates directly to increased profitability – less sap is required per gallon of syrup produced, less labor is required to collect and process the sap, and less energy is required for evaporation as fewer gallons of water are evaporated to produce a gallon of syrup.
Finally, many producers in a position to plant maples, either in plantation, roadside, or as under plantings in a mature stand, are planting seedlings genetically selected for high sap sugar content. These seedlings have been periodically available from several sources for more than 25 years. The sugar content of seedlings grown from one such source, a seed orchard at the Ohio Agricultural Research and Development Center (OARDC), has ranged from 3.7 to 5.8 percent for trees from one to fourteen inches in diameter (Kriebel 1990; Graham 2003). Establishing the future sugarbush with seedlings with sap sugar contents in that range will dramatically improve potential profitability.

The Sugarhouse

The sugarhouse is the production center of a maple operation, where sap collected in the sugarbush may be filtered and stored for a short time, and then processed into maple syrup and packaged. In simplest terms, the production of maple syrup from sap is the process of evaporating the water in the sap and concentrating the sugar into syrup. While this evaporation process is simple in concept, the process is critical for producing high quality maple syrup (Garrett and Dudzik 1989; Heiligmann and Staats 1996). This process also takes considerable knowledge, skill, and equipment to complete.

Historically, water was removed from maple sap and the sugar concentrated over an open fire, with the sap condensed in a metal or iron kettle. These techniques used what are often referred to as “batch-type” evaporators, requiring sap to be continually added to the evaporator until the desired amount of maple
syrup was obtained. Using these techniques, it was not uncommon for it to take days to produce a total of ten gallons of a dark and strong-flavored maple syrup. Since the early 1900s, most maple syrup producers have used a “flue-type” or “continues flow” evaporator, and this technology has become more efficient over time. When compared with the “batch-type” evaporator, a typical “continues flow” evaporator can produce between two to ten gallons per hour (Huyler 1982; Garrett and Dudzik 1989; Heiligmann and Staats 1996).

Producers have also adopted a variety of ancillary equipment (Figure 2.2) to improve efficiency and syrup quality during the evaporation process including: in-line ultraviolet light units to minimize microbial contamination; reverse osmosis units for concentrating sap sugar content prior to boiling, which reduces labor and energy costs and often improves syrup quality; steam hoods (metal covers over the evaporator that trap the steam and exhaust it from the sugarhouse) that preheat the sap and begin the evaporation process; electronic take-off devices that automatically sense when the syrup has reached the proper finished density and open the draw-off valve; and pressure filters for syrup that utilize diatomaceous earth as a filtering medium, producing a syrup with an almost “polished” appearance.
Syrup Packaging

Finished syrup may be graded and then must immediately be properly packaged at a temperature above 180°F for storage, sale, or later processing into candy or other confections. Not all maple syrup is graded. Some states, including Vermont and New Hampshire, have state maple grading standards and require that all syrup be graded according to those standards. Most other states do not have such standards and do not require that maple syrup be graded, but allow those who wish to grade to use U.S.D.A maple grading standards (United States Department of Agriculture 1980). Ohio has state grading standards that follow the USDA

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Ultrapurate Light- used to kill bacteria and other microorganisms in the sap before sap is stored and processes ($600 to $800).
Reverse Osmosis- process in which sap is passed through semi permeable membranes and up to 75% of the water is removed and sap sugar is concentrated, increasing the efficiency of the boiling process and reducing fuel costs ($6,000 to 43,000).
Evaporator- “flue-type” evaporators used to concentrate sugars and produce syrup. ($3,000 to $40,000 depending on size of evaporator).
Pre Heater- improves efficiency by heating sap prior to entering evaporator pan decreasing time needed to boil and reducing the amount of fuel used in the evaporation process ($1,300 to $2,000).
Automatic Draw Off- electronic device that detects syrup temperature and density ($700 to $800).
Hydrometer, Hydrotherm, Refractometer- tools used to measure density or sugar content of syrup ($30 to $50).
Grading Kit- used to determine proper grade for syrup resale ($15 to $600).
Filtering Press- many types from gravity to high pressure systems used to filter syrup after boiling to remove impurities ($250 to $1,500).

Figure 2.2: Some recommended sugarhouse equipment and practices that have been discussed at recent Ohio Maple Days workshops.
standards, but grading is voluntary (Ohio Administrative Code 2004; Ohio Revised Code 1997). Syrup made in Ohio may be sold by grade using either Ohio’s or U.S.D.A.’s maple grades or it can be sold simply as maple syrup. Packaging of syrup in plastic, metal, or glass containers is done a variety of ways, and there is a wide variety of traditional and modern equipment utilized. Similarly, for producers who wish to diversify their products and earn additional “value added” income, a variety of equipment is available for making maple candy, cream, spread, and granulated sugar (Heiligmann 2002; 1992).

Associated Costs of Sugaring

One of the greatest challenges to maple producers is the large capital investment required for both sugarbush and sugarhouse equipment. There is no doubt that “sugaring” is very labor intensive. However, many small forest land owners find the size of the required capital investment to enter the industry prohibitive. For example, an individual wishing to develop a small 100-tap bucket operation starting from scratch and using all newly purchased maple equipment can easily invest $5,000 to $10,000. Most small family-owned producers do not invest anywhere near this much; they reduce their investment by a variety of means, including buying used equipment, using less expensive alternatives such as a flat-pan evaporator rather than a continuous-flow flue evaporator.

The challenge to getting into the maple business is not one of profitability, but of initial investment. Studies from 1985 to 1994 (Sendak and Bennink 1985; Buth 1988; Huyler and Williams 1994) reported the cost of producing a gallon of
maple syrup between $14.41 and $19.89 per gallon, depending on the size of the operation and the collection and processing technology used. During this period syrup was selling for between $23.00 and $38.00 per gallon – certainly an acceptable profit. Unfortunately, many potential maple producers do not calculate profitability by depreciating equipment over its usable life (perhaps 20 to 30 years for an evaporator), they look instead at the initial investment and the expected return, define the point of profit making as the time when they will have paid for all of the equipment, and decide based on that criteria that it is “too expensive” to get into maple syrup production. Since USDA-NASS started to report Ohio maple production within the New England report, the average price per gallon of Ohio maple syrup has been $28.13 with $29.80 per gallon in 2002 being the highest and 1996 $15.00 per gallon the lowest (USDA-NASS 1992-2004).

EVALUATING OHIO STATE UNIVERSITY EXTENSION MAPLE PROGRAMS

Survey Methods

At each of the three Ohio Maple Days workshops in January of 2004, participants were surveyed on the characteristics of their sugarbush, the usefulness of different maple educational programs and publications, the impact past Ohio Maple Days workshops have had on how they manage their sugarbush and sugarhouse, and their level of interest in a variety of subjects pertaining to sugarbush and sugarhouse management. The written survey instrument was developed through a review of past workshop topics, discussions with producers, and a pilot focus group of professionals in the maple industry in other states.
Participants from 40 of Ohio’s 88 counties, as well as from four states (IN, MI, PA, NY), attended the 2004 workshops. Total attendance at the three workshops was \( N = 289 \), with 65% of the attendees \( (n = 190) \) participating in the survey. Of the 190 participants responding to the survey, 92% represented a single, multiple, or cooperative family operation, while 8% of the respondents represented non-family owned maple sugaring enterprises.

Sources of Information

Results of the survey indicated that 82% of the participants relied primarily on the Ohio Maple Days workshops to stay current on issues related to sugarbush and sugarhouse management, while 18% of the respondents relied primarily on workshops and materials provided by the North American Maple Syrup Council (NAMSC), the International Maple Syrup Institute (IMSI), or other states.

Respondents were asked to rank (likert scale 1 to 5) the usefulness of common sources of information on maple syrup production and sugarbush management. Information provided at the Ohio Maple Days workshops was considered the most useful receiving a 4.1 out of 5, followed by other sources, such as the Ohio Maple News newsletter (2.1 out of 5) (Graham 2002), the North American Maple Syrup Producers Manual (2 out of 5) (Koelling and Heiligmann 1996), both publications produced by Ohio State University Extension. These results suggest that the primary source of information for family-owned maple syrup enterprises in Ohio are the Ohio Maple Days workshops provided by OSU Extension. The fact that the Ohio Maple News is produced jointly by the Ohio Maple Producers Association and OSU
Extension, and that the *North American Maple Syrup Producers Manual* is published as an OSU Extension Bulletin further emphasize the important role OSU Extension plays in producer education.

Changes Made In Sugarbush Management

On average, participants responded that they had made few changes in the production, economics, safety, and stand management of their sugarbush in response to information provided at previous Ohio Maple Days workshops. Changes that were implemented were associated with maple syrup production, particularly switching spout types used in the collection of maple sap, increasing the use of sustainable tapping guidelines, and changing to more efficient tubing systems (Figure 2.3).

![Figure 2.3: Level of changes made to management of the sugarbush as the result of Ohio Maple Days education programs. Values are mean scores ± 1 standard error.](image)
The Ohio Maple Days workshops also influenced management activities related to safety and economics; however, the average impact of these educational programs was small. Finally, educational programs designed to inform participants on issues related to stand management, particularly best management practices (BMPs) associated with road and trail management, also had on average some, albeit small, impact on sugarbush management. When asked why few changes in sugarbush management had been adopted, most survey respondents indicated that many were cost-prohibitive under current market conditions.

Changes Made In Sugarhouse Management

When asked about sugarhouse management, as with sugarbush management most participants responded that on average they had implemented relatively few changes following Ohio Maple Days programs. In terms of maple syrup production, most changes in the management of the sugarhouse were associated with changing or improving maple syrup handling, storage, and filtering procedures, as well as equipment cleaning procedures (Figure 2.4). Other important changes were made associated with safety protocols, particularly reducing potential lead contamination of maple syrup from lead-based spouts, handling, and storage equipment, as well as improving maple syrup marketing and sales strategies (Figure 2.4).
Finally, on average few participants implemented new technologies introduced at previous Ohio Maple Days workshops, such as the using in-line ultraviolet lights to treat sap, reverse osmosis units to concentrate sap prior to boiling, or diatomaceous earth sap filters. As with management of the sugarbush, many of the improved technologies associated with increasing the production and quality of maple syrup during processing were considered by many survey respondents as too expensive for their maple syrup operation.
Educational Programming In Sugarbush Management

Respondents were asked to indicate their level of interest in several topics related to the management and production of their sugarbush. On average, production topics that were of highest interest to participants included information on improving tapping systems (including the use of power tapers), tubing systems, and the use of genetically improved super sweet maple trees (Figure 2.5). Additionally, stand management topics of interest to maple syrup producers attending these workshops were related to guidelines for thinning the sugarbush, maintaining the sugarbush (e.g., regeneration, establishment, maintenance of maple trees), and managing forest pests and insects (Figure 2.5).

Figure 2.5: Ohio Maple Days workshop participant level of interest in different sugarbush education programming. Values are mean scores ± 1 standard error.
Educational Programming In Sugarhouse Management

Most respondents stated that information on the use and efficiency of evaporator systems would be of medium to high interest at future Ohio Maple Days workshops (Figure 2.6). Additionally, information on quality control and quality assurance measures, the control of off flavors, and the use and value of implementing new technologies (e.g., pre heater systems, filter press) was of medium interest to the participants. In terms of economic topics, promotional and marketing strategies were of highest interest to participants of the Ohio Maple Days workshops.

Figure 2.6: Ohio Maple Days workshop participant level of interest in different sugarhouse education programming. Values are mean scores ± 1 standard error.
DISCUSSION

Results from our survey of maple syrup enterprises in Ohio suggest that OSU Extension is the primary source of technical information for these small family-owned operations. Most contact with these forest owners is in the form of the Ohio Maple Days workshops, although OSU Extension publications are also a common source of sugarbush and sugarhouse management information. Although past educational programming focused on increasing production and quality, the impact of these programs has been modest, in part because of the relatively high costs associated with newer technologies. The majority of changes to both sugarbush and sugarhouse management following past workshops has been associated with techniques or technologies that are relatively inexpensive and easy to implement. Examples include reducing the number of taps per tree; reducing lead contamination from spouts; collection and processing equipment; changing equipment cleaning procedures in the sugarhouse; and maple sap and syrup handling and storage procedures.

These results are not viewed in any way as suggesting that these educational programs for maple producers have failed to achieve their objectives. This survey identified the level of adoption of practices or technologies presented at Ohio Maple Days annual day-long conferences. As identified above, the primary objective of OSU Extensions program for maple producers is to provide information and training that will enable them to make effective decisions and implement appropriate new technologies and research to increase their productivity and profitability. Some producers obviously found various practices and technologies presented at Ohio
Maple Days programs to be appropriate for their enterprise, others did not. The fact that many did not, but could identify the reason as cost or some other factor, suggests that they received the information needed to make an effective decision.

In addition to providing an array of topics with high producer interest for future workshops, this survey emphasizes the importance of providing information on the cost of implementing recommended practices or technologies and the value received. To some extent, all maple producers have an interest in hearing about all new practices and technologies associated with making maple products. However, when it comes to adoption, they will make their decision based on whether or not the practice or technology is appropriate for their specific operation, the cost of adoption, and whether or not adoption will provide them with sufficient value (monetary or otherwise) to justify the cost. As OSU Extension and others design future programs, it is critical that information be provided that supports that decision-making process.


Ohio Administrative Code. 2004. Mandatory food sampling tolerance level standards and action steps for maple syrup, sorghum, and honey. OAC 901:3-44-01, OAC 901:3-45-01 to 901:3-46-09.


ABSTRACT

Despite over 90 years of service by Ohio State University (OSU) Extension, little information is available concerning the Ohio maple syrup industry. Initial surveys conducted in 2004 at OSU Extension Ohio Maple Days maple syrup education programs revealed that 82% of attendees relied primarily on OSU Extension programs to stay current with maple production practices, further justifying the need for information on production practices and producer demographics. In 2004, a detailed survey was conducted of all known Ohio maple syrup producers with the goal of elucidating relationships among production factors and demographic characteristics. An overall response rate of 81% (N = 620) was achieved. Based on these surveys, the maple syrup industry in Ohio is best characterized as a very traditional enterprise of small, second-generation, family-owned sugarbushes, which predominately utilize bucket collection systems.
Specifically, 62% of all taps and 78% of all sugaring operations utilize bucket collection systems versus the more modern tubing collections systems. The average sugarhouse has a 13 year-old evaporator fired by wood with little insulation and few attachments, thus resulting in a relatively inefficient production facility in a very labor intensive industry. Producers reported that over 90% of their syrup sales are within Ohio and that only 11% sell syrup by grade. Finally, producers indicated that sugarbush management and processing practices were the most important topics they wished to see developed in educational programs developed by OSU Extension.

INTRODUCTION

Over 30% of Ohio's land base consists of diverse forests that are a significant natural resource. Over 97% of these forests are dominated by hardwoods, and the majority of these forests (about 94%) are owned by private landowners (Ohio Forestry Association 2003). These forests help support the forest products, maple syrup, and Christmas tree industries, which together annually account for $7 to $16 billion of Ohio’s economic output (Ohio Forestry Association 2003). Despite these important economic contributions, the potential exists for substantial economic development in the forest products sector.

One of the most important non-timber forest products produced in Ohio is maple syrup. On average Ohio is the fifth largest maple syrup producing state, producing about 4% of the total volume of maple syrup in the United States in 2003
While the total volume of maple syrup produced has declined by 15% over the past decade, sales of maple syrup and related maple products annually contribute approximately $2.5 million dollars to Ohio’s economy (USDA-NASS 1992-2004). While conservative estimates suggest that this represents only 0.4% of total economic output provided by the forest products industry in the state, it may be possible to expand the maple syrup market through improvements in sugarbush stand management, syrup production methods, and marketing. However, to accomplish this, more information on the maple syrup industry as a whole is needed. Currently, the only market information available is from United States Department of Agriculture - National Agricultural Statistic Service (USDA-NASS), and this information is limited in scope as USDA-NASS focuses only on a limited sub-sample of producers that have greater than 100 taps.

The objectives of this survey were to: 1) identify current maple syrup production practices and methods used; 2) identify characteristics of sugarbush management practices, and equipment used to produce syrup; 3) identify the characteristics of Ohio producers; and 4) identify the sources of information used and the issues facing maple producers. This information will enhance OSU Extension’s ability to provide the latest research-based educational materials and programming to this important non-timber forest-based industry.

This research was designed to query all producers irrespective of size (number of taps), collection method (buckets or tubing), geographic location, age, experience, or cultural heritage. The report also examines educational resources available to maple syrup producers in the state, with a particular emphasis on
outreach programs developed by Ohio State University (OSU) Extension. Finally, the report suggests ways in which the maple syrup industry might enhance productivity and expand Ohio’s maple syrup industry sector.

BACKGROUND

History of Maple Syrup Production

The first written accounts of maple sugaring appeared in the early 1500s by French Explorers as the native cultures these explorers encountered shared their sugaring practices (Moore, Anderson, and Baker 1951; Lawrence, Martin, and Boisvert 1993; Wittstock and Kakkak 1993; Koelling and Davenport 1996). James Smith, a settler who had been taken prisoner by the Caughnawagas Indians of the Ohio Valley in 1756, is credited with Ohio’s first written account of maple sugaring (Lawrence, Martin, and Boisvert 1993). He described a very basic process of collecting maple sap from large gashes on the stems of maple trees and boiling down the sap in hollowed-out stumps. These basic sugaring techniques were borrowed from the Native Americans and improved upon by early settlers, providing early Americans with a staple sugar crop. The market for maple sugar expanded rapidly during the 1700s and 1800s due to the expense of importing cane sugar from the West Indies. Furthermore, foreign reliance on cane sugar was looked upon negatively, so much so that in 1791 after visiting Vermont, Thomas Jefferson suggested that every citizen should have a maple orchard or sugarbush to produce sugar and reduce reliance on foreign cane sugar (Lawrence, Martin, and Boisvert 1993).
Historical Production Levels

Maple syrup production is a uniquely North American practice, and produced nowhere else in the world (Figure 3.1). As a whole, the USDA-NASS reports that maple syrup production contributed $1.8 million to Ohio’s economy, $35.6 million to the United States economy, and $114.5 million to the Canadian economy in 2003 (USDA-NASS 2004). Despite Ohio only producing 0.6% and 4.0% of the world and United States maple syrup crop, respectively, in 2003 (USDA-NASS 2004), Ohio has a long history of producing large amounts of maple products. In the first agricultural census of 1840, Ohio was the top producer with 6.3 million pounds of sugar (United States Census 1840) and in 1870 Ohio was responsible for producing 38% of the maple crop with a record United States production of 921,057 gallons of syrup (United States Census 1870).

![Maple syrup production region of North America.](image)

**Figure 3.1:** Maple syrup production region of North America. *(North American Maple Producers Manual, Koelling and Heiligmann 1996)*
Since 1992 USDA-NASS has tracked maple syrup production in Ohio. Over the past twelve years, Ohio on average, ranks as the fifth largest maple syrup producing state behind Vermont, Maine, New York, and Wisconsin, with approximately 400,000 taps producing 75,000 gallons a year at an average price of $30.46 per gallon (USDA-NASS 1992-2004). The largest maple production area in the world remains the Province of Quebec, Canada, which produced 79% of the North American maple crop in 2003 (USDA-NASS 2004).

Historical Development of the Maple Industry

Maple syrup production equipment has evolved with the industry as producers experimented with new tools and methods designed to improve sugar quality and quantity. Settlers learned from the Native Americans to cut a gash in the maple tree, using bark to direct sap into hollowed-out logs, birch bark bowls, or clay pots. Early settlers boiled the sap in iron or copper kettles to remove the water, leaving just the granulated sugar. Wooden buckets would eventually replace other collection methods, but kettle boiling remained the primary method of evaporating maple sap to sugar until the mid 1800s. Tin, a by-product of a new food storage system from the Civil War, was one such technical advancement utilized by the maple industry (Cook 1887; Lawrence, Martin, and Boisvert 1993). Tin was found to be a better heat conductor and when formed into flat pans it increased evaporation rates over the thick, heavy iron and copper kettles of the day.
Today’s modern designed evaporators are based on an 1872 patent from a Vermont sugar maker’s design called the “King Evaporator” (Leader Evaporator Co., Inc. 1984; Lawrence, Martin, and Boisvert 1993). The name “King Evaporator” is still one of the product lines available by the Leader Evaporator Company, Inc. of St. Albans, Vermont. Several evaporator patents were also held by Ohio inventors, and manufacturing companies and these companies played an important role in the development of “continuous flow” evaporators, the current industry standard. Tin was also used to improve spout designs which had many manufacturing and cleaning qualities over hollowed-out sumac or elder stems (Koelling and Davenport 1996). Tin buckets would also eventually replace wooden buckets that were heavy, bulky, and required frequent painting to keep them from drying up and springing leaks.

Maple Syrup Industry Regulations

Maple syrup production tends to be a cash-based supplemental income, and most producers are hesitant to reveal sensitive information about their production volumes (e.g., number of taps, gallons produced) (Demchik et al. 2000). The maple industry in Ohio is not regulated and producers do not have to register their sugaring operation with the state. Regulations and guidelines regarding maple syrup production do exist; however, they are entirely voluntary. Several states have registration requirements, but few require detailed operation information to be submitted making the maple industry a “laisser-faire” or hands-off entity.
Ohio also has a voluntary grading standard which follows USDA standards for grades of maple syrup as listed within sections §52.5961 to §52.5968 of federal code (United States Department of Agriculture 1980). Additionally, Ohio has a voluntary maple production inspection regulation program enacted February 2, 2004, that establishes tolerance levels and action steps adopted by the Ohio Department of Agriculture to serve as a regulation standard. These guidelines were established to inspect an operation’s product and production facilities, and if deemed fit, to label the facility as a certified state inspected site. The guidelines are in the Ohio Administrative code (901:3-44-01) as administered by the Ohio Revised Code (3715.59) (United States Department of Agriculture 1980; Ohio Revised Code 1997; Ohio Administrative Code 2004).

Role of Ohio State University Extension

For over 90 years OSU Extension has served Ohio maple producers with the latest research-based information and training enabling Ohio producers to make effective decisions, implement appropriate new technologies, and increase production and profits. A 2003 survey of attendees to the OSU Extension sponsored Ohio Maple Days workshops revealed that OSU Extension is having a positive impact on their maple operations (see Chapter 2). Participants further reported that they had made structural, management, and financial changes and adjustments due to the lessons learned from the Ohio Maple Days workshops, and that these changes had improved their sugaring operation. Of the most common
educational resources consulted by producers attending the workshops, three of the top five resources were OSU Extension programs or publications (e.g., Ohio Maple Days workshops, Ohio Maple Producers Association newsletter called The Ohio Maple News, and North American Maple Syrup Producers Manual.

Ohio Maple Producers Association

The Ohio Maple Producers Association (OMPA) was formed in 1986 after 75% of Ohio producers responded favorably for the formation of an association to represent them (Passewitz and Donnermeyer 1989). The association has grown 50% over the last 19 years, and the 13 member board of directors represents producers from across the maple producing region of Ohio (Graham 2005). Since 1986, OSU Extension has collaborated with OMPA in maple education and promotion efforts. In 2002, OSU Extension assumed editorship and publication of the Ohio Maple News newsletter distributed quarterly to OMPA members and Extension Specialists within the international maple production region (Graham 2002).

METHODS

Maple Producer Survey

In May 2004, all Ohio maple producers on a list (N = 1,050) compiled from OSU Extension and private source lists were sent a detailed questionnaire with 84 questions focused on different aspects of each producer’s sugaring operation. These included: sap collection and handling methods; sap to syrup processing;
quality control issues through each step of the syrup-making process; packaging and sales; demographic characteristics; and researched-based knowledge needs of all producers.

The questionnaire and the survey process followed “The Tailored Design Method” (Dillman 2000) because it places greater emphasis on the social exchange perspective for why people respond to or do not respond to a survey (Dillman 1978; Dillman 2000). The flow, language, and structure of the questionnaire were designed to be user-friendly and convenient. Self-addressed stamped envelopes were provided as well.

Professionals in academic or agency related positions specializing in maple syrup, natural resources, and/or survey administration, as well as maple producers themselves were consulted during the development of this instrument. The questionnaire was field tested by a pilot group of 25 producers across the state. The pilot group consisted of both large and small (number of taps) producers, both bucket and tubing collection operations, both Amish and non-Amish (English), those active and inactive in the OSU Extension maple programs, and the Ohio Maple Producers Association- in order to obtain a well-balanced test group. Ninety-six percent (n = 24) returned their questionnaire with suggested changes and comments for clarity and ease of use, and based upon these comments a final questionnaire instrument was developed. A copy of the final survey can be viewed at [http://snr.osu.edu/research/goebel/web/2004%20HMapleSurvey.pdf](http://snr.osu.edu/research/goebel/web/2004%20HMapleSurvey.pdf).
An overall response rate of 81% \((N = 620)\) was achieved from a master mailing list of 761 producers. Of the 620 questionnaires returned from active maple operations, 78\% \((n = 485)\) are first questionnaire responders; 13\% \((n = 82)\) are second questionnaire responders, and the 8\% \((n = 53)\) are third round responders. Follow-up phone calls as suggested by Dillman (2000) were not utilized because of a significant Amish producer population that would not have been reached using this method. A total of 289 questionnaires were removed from the original mail list \((N = 1,050)\) due to the following: 186 were from respondents no longer producing maple syrup; 52 were from respondents who never produced maple syrup; and 51 were returned blank with no indication of their status within the maple syrup industry. After seven regular mailings, including one priority mailing there were 141 who did not respond and never returned any of the three questionnaires sent.

**Reporting the Results of the Survey**

Information from the returned questionnaires \((n = 909)\) were entered into Microsoft® Access 2003, and then transferred into Microsoft® Excel for organization of the 620 questionnaires that represented active maple sugaring operations. Data was analyzed using MINITAB® Release 14 statistical software (Minitab 2003). A 20\% \((n = 124)\) sub-sample of questionnaires was randomly pulled and all entries were verified with the information in the database and original samples. An acceptable error rate of .0002\% was observed; thus, it was concluded further verification was not needed (Dillman 1978; Dillman 2000).
RESULTS

Characteristics of Ohio Maple Producers

The 620 maple syrup operations are located across Ohio in 69 of Ohio’s 88 counties (Figure 3.2). As anticipated, northeast Ohio has the largest concentration of maple syrup operations. Geauga County had the highest density of operations with 153 (25%), followed by Trumbull (6%; \( n = 35 \)), Ashland (5%; \( n = 29 \)), Medina (5%; \( n = 29 \)), and Portage (5%; \( n = 29 \)) counties. Middlefield Township in Geauga County had the highest number of operations from a township (18%; \( n = 28 \)).

Twenty-five percent of respondents indicated they were of Amish heritage (\( n = 153 \)), and 75% (\( n = 467 \)) were of non-Amish or English heritage. The average age of Ohio maple producers is 53 years, with a range from 16 to 90 years. Age distribution is as follows: 16% (\( n = 100 \)) of the producers are between 16 and 40 years of age; 29% (\( n = 178 \)) are between 41 and 50 years of age; 26% (\( n = 161 \)) are between 51 and 60 years of age; and 28% (\( n = 170 \)) are between 61 to 90 years of age (Figure 3.3).

Figure 3.3: Age range distribution of Ohio maple producers.
Figure 3.2 Number of maple syrup producers and taps reported by county within the 2004 Ohio maple syrup industry research project.
The average producer has 19 years of experience in the maple industry. When compared with other surveys (Table 3.1), Ohio producers today have on average six more years of experience than the producers sampled in the 1986 Ohio survey (Passewitz and Donnermeyer 1989), two more years experience than those surveyed in Maine in 2000 (Hopkins 2002), and four less years experience than maple producers surveyed in Michigan in 1975 (Gunter and Koelling 1975).

The average number of generations producing maple syrup is 1.9 or two generations with the range of 1 to 8 generations. Forty-seven percent ($n = 290$) indicated that there is a new generation to take over the sugaring operation, while 48% ($n = 298$) indicated there was not. The remaining 5% ($n = 32$) did not indicate either way. Finally, 34% of survey respondents indicated they were members of Ohio Maple Producers Association, with an average membership of five years. Thirty-four individuals (6%) indicated they were charter members of OMPA when it was organized in 1986.

<table>
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</tbody>
</table>

Eighty-nine percent \((n = 551)\) of respondents indicated they were males while 8\% \((n = 49)\) indicated they were females with the remaining 3\% \((n = 20)\) not indicating either way. Only 0.5\% \((n = 3)\) of producers indicated that maple syrup producing was their full time occupation \((n = 567)\) (Figure 3.4). The majority of producers (60\%) indicated their full-time occupation as a technical or trade field \((n = 169)\) or agriculturally-related \((n = 168)\). The remaining producers indicated they were retired (19\%); worked in an executive or professional field (17\%); were homemakers (3\%), or did not answer (3\%). Most producers also indicated that their maple syrup operations were family-owned. Specifically, 90\% \((n = 556)\) of the sugaring operations indicated they are family-owned, while corporate-owned operations comprise only 3\% \((n = 18)\) of all operations surveyed (Figure 3.5). The remaining 7\% of maple operations were identified as rented or leased \((n = 17)\), operated by multiple owners \((n = 12)\), or cooperatively-owned sugaring operations \((n = 3)\). Two percent of the producers \((n = 14)\) did not answer this question.

Figure 3.4: Fulltime occupation of Ohio maple producers.
Characteristics of the Sugarbush

The average sugarbush in Ohio is 27 acres, ranging in size from 0.25 acres to 190 acres. The majority of sugarbushes were below the average size, with 26% \( (n = 154) \) in the 1 - 9 acre size range and 40% \( (n = 235) \) in the 10 - 25 acre range. For those sugarbushes larger than the average size, 20% \( (n = 119) \) ranged from 26 - 50 acres, 11% \( (n = 65) \) ranged from 50 - 100 acres, and only 2% \( (n = 12) \) were greater than 100 acres \( (N = 585) \). Most producers (87%) indicated that their sugarbush was uneven-aged, while 11% indicated that their sugarbush was an even-aged stand. In terms of tapping potential, 71% of producers indicated they had sufficient trees in the sugarbush to expand their operation, while 24% indicated they had reached full tapping potential. The remaining 5% did not know or did not respond (Figure 3.6). Finally, while 90% \( (n = 556) \) of respondents indicated the sugaring...
operation was family-owned (Figure 3.5), only 75% ($n = 425$) indicated a “sugarbush they owned” as a source of maple sap (Figure 3.7). Thirty-nine percent indicated sugarbushes or trees were leased and accounted for part of their sap, while 18% indicated yard and street trees were used. Only 1% of respondents indicated they purchased sap.

![Figure 3.7: Source of sap in Ohio's sugaring operations.](image)

![Figure 3.6: Tapping potential as reported within Ohio.](image)
Conservative tapping guidelines developed by the international maple industry in the mid 1980s were designed to protect the trees health (Table 3.2) (Heiligmann et al. 1996; Heiligmann 1992). Only 37% \((n = 210)\) of producers indicated they follow these guidelines; 5% \((n = 31)\) indicated they do not follow them; and 55% \((n = 313)\) were not aware of the guidelines \((N = 567)\). However, regardless of whether the producer was aware of the conservative tapping guidelines or not, 68% \((n = 383)\) of producers indicated they monitor crop tree health and adjust the tapping pressure accordingly, 9% \((n = 52)\) indicated they sometimes adjusted tapping pressure, and 23% \((n = 132)\) indicated they did not adjust their tapping pressure in response to declining tree health.

<table>
<thead>
<tr>
<th>Tree Diameter</th>
<th>Tree Circumferences</th>
<th>Number of Taps Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>12” to 18”</td>
<td>38” to 57”</td>
<td>1 tap</td>
</tr>
<tr>
<td>18” +</td>
<td>57” +</td>
<td>2 taps</td>
</tr>
</tbody>
</table>

*North American Maple Syrup Producers Manual

Table 3.2: Recommended tapping guidelines for sugar maple production.*

Producers did indicate that several strategies are used to determine the tapping date. The majority of producers \((75%; n = 513)\) tap according to the weather conditions, while 16% \((n = 112)\) tap by a traditional calendar date (e.g. February 15th). Approximately 8% \((n = 53)\) of the producers suggested they tap when others around them tap, and 1% \((n = 10)\) indicated they tap using another strategy, most commonly when family or friends could assist in tapping and sap collection.
Sap Collection

Respondents to the survey reported a total of 374,724 taps in the state (Figure 3.2). Bucket collection systems accounted for 62% (232,249) of the all taps reported, while tubing collection systems accounted for 38% (142,475) of all taps (Figure 3.8). Approximately one quarter of the maple producers utilize both bucket and tubing systems (23%; n = 142); however, for the purposes of this analysis respondents who reported both bucket and tubing collections systems were assigned to the dominate collection system (e.g. an operation with a total of 525 taps (450 on tubing and 75 on buckets) would be considered a tubing operation). When considered in this fashion, producers primarily relying on bucket collection systems accounted for 78% (n = 485) of all sugaring operations and tubing collection methods accounted for 22% (n = 135) of all operations (Figure 3.8).

![Collection System Type](image)

**Figure 3.8:** Percent taps on buckets vs. tubing, and percent operations with bucket or tubing collection systems.
Producers were separated into one of five size classification categories based on the number of taps, including: “Hobby” (less than 100 taps); “Small Retail-Wholesale” (101 to 250 taps); “Medium Retail-Wholesale” (251 to 500 taps); “Large Retail-Wholesale” (501 to 1,000 taps); and “Commercial” (more than 1,000 taps) (Table 3.3). These size classifications are used throughout this report regardless of collection system. When examining collection methods associated with the different production categories, 36% \((n = 222)\) of all operations are in the hobby category and represent 3% of all taps (10,834 taps). The small retail-wholesale category represents 23% \((n = 146)\) of all operations and 7% of all taps (25,063 taps), the medium retail-wholesale category represents 24% \((n = 150)\) of all operations and 16% of all taps (58,568 taps), and the large retail-wholesale category represents 24% \((n = 147)\) of all operations and 26% of all taps (99,406 taps). Only 14% \((n = 90)\) of all operations would be classified as commercial, however, 48% of all taps (180,853 taps) are associated with these commercial operations.

<table>
<thead>
<tr>
<th>Classification Category</th>
<th>Number of Taps</th>
<th>Projected Production 1 Quart per tap*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hobby</td>
<td>&lt; 100</td>
<td>25 gal</td>
</tr>
<tr>
<td>Small Retail Wholesale</td>
<td>101 – 250</td>
<td>25 – 63 gal</td>
</tr>
<tr>
<td>Medium Retail Wholesale</td>
<td>251 – 500</td>
<td>63 – 125 gal</td>
</tr>
<tr>
<td>Large Retail Wholesale</td>
<td>501 – 1,000</td>
<td>125 – 250 gal</td>
</tr>
<tr>
<td>Commercial</td>
<td>&gt; 1,000</td>
<td>&gt; 250 gal</td>
</tr>
</tbody>
</table>

* average production reported by respondents

Table 3.3: Sugaring operation and production size classification categories.
Bucket Collection Systems

The average bucket collection operation in Ohio has 417 taps, ranging from as few as 4 to a high of 5,000 taps. When examining bucket operations within the five classification categories, the following trends were observed: 33% \((n = 186)\) of bucket operations are in the hobby category representing 2% of all taps \((n = 8,936\) taps); 19% \((n = 104)\) of all bucket operations are in the small retail-wholesale category representing 5% of all taps \((n = 17,549\) taps); 20% \((n = 111)\) of bucket operations are in the medium retail-wholesale category representing 11% of all taps \((n = 43,013\) taps); 19% \((n = 104)\) of bucket operations are in the large retail-wholesale category representing 19% of all taps \((n = 66,851\) taps); and, 9% \((n = 52)\) of bucket operations are in the commercial category representing 26% of all taps \((n = 95,900\) taps).

Within bucket collection systems indicated they use traditional galvanized buckets \((62\%; n = 343)\) (Figure 3.9). In many instances producers utilize more than one collection container type (e.g., galvanized metal buckets and plastic buckets), thus the following analysis includes a total of 702 responses. Thirty–eight percent of producers using bucket collection systems relied on the following: 26% \((n = 144)\) use 5-gallon plastic buckets; 15% \((n = 84)\) use 1 to 4-gallon plastic buckets; 13% \((n = 74)\) use plastic sap sacks or food grade bags; 5% \((n = 29)\) use milk or water jugs; 3% \((n = 17)\) use aluminum buckets; and 2% \((n = 11)\) use a different type of collection system not specified in the survey.
In terms of transporting sap collected in buckets to the sugarhouse, 33% percent \((n = 184)\) indicate they use a wheeled wagon, while 17% \((n = 96)\) used a traditional skid with wooden runners (Figure 3.10). The most common power unit associated with wagon collection systems were tractors (29% of producers; \(n = 162\)) closely followed by the more traditional horse team (24% of producers; \(n = 136\)). However, other producers indicated they use the following modes of transportation to move sap from buckets to the sugarhouse: 20% \((n = 110)\) indicated they hand carry a portion or all of the sap to the sugarhouse; 14% \((n = 76)\) indicated an All Terrain Vehicle (ATV) was used; 13% \((n = 71)\) indicated an automobile with a collection tank; 13% \((n = 71)\) indicated a lawn tractor was used; and, 8% \((n = 42)\) indicated some other form of transportation such as two-wheeled trailers, wheel borrows, golf carts, and bikes. Most producers indicated they use either a plastic (polyurethane) (50%; \(n = 280\)) or a traditional galvanized metal tank
(31%; n = 172) to collect sap from bucket systems and transport to the sugarhouse.

The remaining producers (14%; n = 78) indicated steel, aluminum, stainless steel or “other” type of transport tank was used.

The majority of producers (79%; n = 450) using bucket collection systems reported that they cleaned the bucket sap collection system, while only 1% (n = 5) of producers indicated that they do not clean their collection system because they feel it was not important to do so, and the remaining 20% either do not clean the collection system or left the question blank. Among those reporting cleaning the system, 75% (n = 419) are cleaned at the start of the season, while 59% (n = 329) are cleaned at the end of the season (Figure 3.11). The remainder of producers using bucket system indicated they clean their systems after a warm spell (32%; n = 177), after each run (26%; n = 144), after a large run (13% (n = 71), or when time allows (11%; n = 62).
In terms of cleaning agents used, 34% \((n = 188)\) indicated they used only water, 31% \((n = 171)\) used soap and water, 29% \((n = 160)\) use chlorine bleach, 2% \((n = 13)\) use vinegar, 2% \((n = 11)\) use powered chlorinated sanitizer (PCS), 1% \((n = 6)\) use commercial tubing cleaner, 0.5% \((n = 3)\) use phosphoric acid, 0.5% \((n = 3)\) use sulfamic acid, and 0.2% \((n = 1)\) use gluconic acid. Fourteen percent \((n = 73)\) of producers indicated they throw the container away after use (using disposable sap sacks, or food grade bags) and 4% \((n = 25)\) indicated some other cleaning agent was used to clean the buckets, including baking soda, Oxyclean®, dish washer powder, Comet® utility cleaner, and hydrogen peroxide. While the industry standard for using chlorine as a cleaning agent is 20:1 (20 parts water and one part unscented household type bleach which is generally 5.25% sodium hypochlorite solution) (Heiligmann and Staats 1996; Lachance and Blais 2001; Hopkins 2002), only six producers indicated using the proper dilution rate. Over 81% \((n = 318)\) of respondents did not know the dilution rate used \((N = 393)\) and the remaining producers used a wide range of dilution rates from 3:1 to 960:1.

![Figure 3.11: Indication of bucket system cleaning.](image-url)
Tubing Collection Systems

Tubing collection systems represent 22% ($n = 135$) of maple syrup operations in Ohio and 38% (142,475) of all taps. The average tubing operation in Ohio has 720 taps, ranging from 12 to 6,500 taps. When tubing operations are compared by size, 18% ($n = 36$) of all operations are classified as hobby operations (1% of all taps; $n = 1,898$ taps), 21% ($n = 42$) are classified as small retail-wholesale operations (2% of all taps; $n = 7,514$ taps), 20% ($n = 39$) are classified as medium retail-wholesale operations (4% of all taps; $n = 15,555$ taps), 22% ($n = 43$) are classified as large retail-wholesale operations (9% of all taps; $n = 32,555$ taps), and 19% ($n = 38$) are classified as commercial operations (23% of all taps; $n = 84,953$ taps) (Table 3.4).

All three types of tubing (rigid poly, semi-rigid poly, soft poly) are commonly used by Ohio producers. In terms of drop lines, 57% ($n = 113$) of producers use soft poly tubing; 20% ($n = 39$) use rigid poly tubing, and 10% ($n = 20$) use semi-rigid poly tubing. Thirteen percent ($n = 26$) of producers that utilize tubing collection systems did not respond to the question. Producers also indicated the similar types of tubing were used for lateral lines. Specifically, 31% ($n = 62$) of producers use soft poly tubing, 29% ($n = 57$) use semi-rigid poly tubing, 25% ($n = 50$) use rigid poly tubing as the majority of their lateral lines, and 15% of producers did not respond to the question.

Historically since the advent of tubing systems in the 1960s, tubing was laid on top of the ground and gravity pulled the sap down slope to a collection point. However, since the 1980s, it has been recommended that tubing be suspended
above the ground. Seventy-three percent \((n = 144)\) of producers using tubing collection systems indicated that their tubing was suspended above the ground while 20\% \((n = 40)\) indicated the tubing is still laid on the ground surface; 6\% of respondents did not answer the question. Two producers (1\%) indicated their tubing is buried underground. Most tubing operations (71\% of tubing producers; \(n = 123\)) utilize a dendritic layout pattern, while the remaining tubing operations either use a parallel layout pattern (17\%; \(n = 29\)) or a radial layout pattern (12\%; \(n = 20\)) (Figure 3.12).
Option 1: 71% (123) chose the dendritic (tree like) tubing system layout.

Option 2: 17% (29) chose the parallel tubing system layout.

Option 3: 12% (20) chose the radial (like wheel spokes) tubing system layout.

Figure 3.12: Typical tubing layout patterns used.
Originally when tubing was laid upon the ground surface, it was vented to create natural vacuum aiding the flow of sap to an area of lower elevation. Respondents were asked if their tubing system used vacuum or gravity for sap collection, however they were not asked if the system was vented as this method has not been recommended since the mid 1970s. Sixty-one percent (n = 121) of respondents indicated they used gravity or natural vacuum for sap collection, with several indicating they still use vented systems. Only 29% (n = 58) indicated that they used artificial vacuum within their tubing collection system, while 10% (n = 19) did not respond to the question. For those using a vacuum pump, 79% (n = 46) indicated they used a rotary vacuum pump, 7% (n = 4) use a diaphragm vacuum pump, and 5% (n = 3) indicated they used a piston pump vacuum system (Figure 3.13). As the pressure of the pump and at the tree (inches of mercury vacuum; Hg) is important to ensure an efficiently functioning vacuum system, it is critical that such information be known to ensure the flow of sap to the collection point (the industry standard is 15 Hg) (Heiligmann and Staats 1996). While 84% (n = 49) of respondents knew the pressure (Hg) pulled at the pump, only 43% (n = 25) were aware of the pressure (Hg) at the tree. For those producers that had data on the pressure pulled from the pump (n = 49) and at the tree (n = 25), the average was 18 Hg and 15 Hg, respectively.
Seventy-six percent ($n = 151$) of respondents do clean their tubing systems, with 24% ($n = 47$) indicating they do not. For those not cleaning the tubing system, only about a quarter of the producers ($n = 12$) indicated why with six producers stating they lacked the necessary equipment, three producers stating they lack the time, two producers indicating it was not important, and one producer suggesting that more help was needed. For those who do clean the tubing systems, 59% ($n = 117$) clean at the start of the season and 84% ($n = 166$) clean at season’s end. However, a number of producers do not clean the tubing system at the beginning or end of the season; rather they clean after a warm spell (23%; $n = 46$), clean when time allows (10%; $n = 20$), clean after each run (5%; $n = 9$), or clean after a large run (several days of sap flow) (4%; $n = 8$) (Figure 3.14).

Figure 3.13: Collection methods within tubing systems.
For those producers cleaning their tubing systems at the end of the maple season, most clean their system with water (35%; \( n = 66 \)), chlorine bleach (32%; \( n = 60 \)), or water and injected air (17%; \( n = 33 \)). Only 11% (\( n = 21 \)) of producers use commercial tubing cleaner while 6% (\( n = 12 \)) use soap and water, 3% (\( n = 6 \)) use phosphoric acid, and 3% (\( n = 6 \)) use vinegar. Powered chlorinated sanitizer (PCS) and sulfamic acid were used by 1% of producers, respectively. Finally, 3% (\( n = 5 \)) of producers indicated they used other cleaning agents such as a bromine solution, hydrogen peroxide, alcohol, soda, and air to clean the tubing system at season’s end (Figure 3.15). Of the 90 respondents using chemical cleaners at the end of the season, 64% (\( n = 58 \)) reported a dilution rate while 36% (\( n = 32 \)) did not know or report the dilution rate used. Of the respondents using chlorine bleach, five indicated a proper industry standard ratio of 20:1; the remaining ratios fell within a range of 3:1 to 1,500:1.
Similarly, of those producers (52%; \( n = 104 \)) indicating they also cleaned the tubing systems mid-season, 54% of them (\( n = 48 \)) use only water, 20% (\( n = 18 \)) use water and injected air, 17% (\( n = 15 \)) use chlorine bleach, 2% (\( n = 2 \)) use powered chlorinated sanitizer (PCS), and 1% (\( n = 1 \)) use commercial tubing cleaner, vinegar, soap and water. No respondents indicated they used phosphoric acid, sulfamic acid, or gluconic acid to clean the tubing system at mid-season (Figure 3.15). Only 25% of producers cleaning their tubing systems (\( n = 22 \)) mid-season, using a cleaning agent, knew the dilution rate; however, none used an industry standard rate of 20:1. Dilution rates ranged from 8:1 to 400:1.

While leaving the taps in the tree at seasons end is practiced in parts the maple region, traditionally taps are removed from crop trees in Ohio at the end of each maple season. However, 13% (\( n = 26 \)) of producers indicated that they do not remove taps from the tree at season’s end. Similarly, 62% (\( n = 109 \)) of producers using tubing collection systems remove the tubing system at season’s end while 7% (\( n = 12 \)) only take down a portion of the tubing network.
Figure 3.15: Cleaning agents reported used for (A) mid season and (B) end of season cleaning of tubing systems.

Sap Handling, Storage, and Filtering

Sap is best processed while fresh (Heiligmann et al. 1996); however, only 55% \((n = 314)\) of respondents indicated they boil the same day of sap collection. Of the remaining 45% of maple producers surveyed, 34% \((n = 191)\) hold sap for 1-2 days following collection before processing, 7% \((n = 38)\) hold for 3-4 days, and 2.3%
of producers hold sap for more than 5 days before processing (Figure 3.16). For those producers that store maple sap before processing, producers indicated they utilize tanks constructed from the following materials: polyurethane or plastic (38%; \(n = 215\)); galvanized metal (36%; \(n = 203\)), or stainless steel (35%; \(n = 199\)) (Figure 3.17). Only 1% of maple producers responded that they use either aluminum (\(n = 8\)) or concrete vaults (\(n = 7\)), while 3% (\(n = 19\)) indicated some other type of storage material such as livestock water tanks, trash cans, steel barrels, and pond lines in a wood frame.

![Figure 3.16: Average number of days from sap collection until boiling.](image)

Figure 3.16: Average number of days from sap collection until boiling.
When surveyed about cleaning of the sap storage units, the majority of producers (66%; n = 377) indicated they clean their facilities prior to the new season, while 53% (n = 300) clean at the end of the season (Figure 3.18). In between the start and end of the season, 33% (n = 188) clean after a warm spell; 33% (n = 187) clean after each run; 15% (n = 88) clean after a large run (a run lasting several days); and the remaining 5% (n = 30) indicated they had some other cleaning regime, such as cleaning the storage tanks when needed or when they looked dirty.

Figure 3.17: Sap storage tank material type.
In terms of filtering maple sap prior to processing, 95% of producers indicated they filter sap before boiling. A cloth filter was the most common type utilized (71%; \( n = 405 \)), followed by a mesh screen (25%; \( n = 143 \)) or canister filters (17%; \( n = 98 \)). Only 3% (\( n = 15 \)) of producers indicate they use diatomaceous earth (DE) in the filtering system, and 7% (\( n = 37 \)) process the sap through an ultraviolet (UV) light. Approximately 5% (\( n = 31 \)) of producers indicated they used some other form of filtering, such as dairy pipeline sock filters (\( n = 8 \)), felt cloth (\( n = 6 \)), or paper towels and coffee filters (\( n = 4 \)).
Sugarhouse Characteristics

Based on the survey responses, the typical sugarhouse in Ohio has wood walls (75%), a metal roof (68%), a concrete floor for at least half of the area (50%), and an open interior through the rafters to the cupola ventilator (68%). Eleven percent \((n = 71)\) of producers reported they do not have a sugarhouse, with 9% \((n = 56)\) indicating they boil in the open and 2% \((n = 15)\) indicating they only boil in the kitchen inside their residence. Tools and equipment indicated in the sugarhouse were as follows: 61% \((n = 305)\) indicated they had electric lighting, and 16% \((n = 80)\) indicated they had gas or fuel lighting, leaving 22% \((n = 111)\) who either have no lighting or did not answer the question (Figure 3.19). Only 34% \((n = 169)\) indicated having running water in the sugarhouse, and 45% \((n = 222)\) of producers reported they can or bottle syrup in the sugarhouse, with the remaining utilizing a caning room or not answering the question. Thirty percent \((n = 148)\) of operations have an observation area for visitors, however only 6% \((n = 30)\) used educational materials to inform visitors of the maple sugaring process. Only 5% \((n = 23)\) of producers indicated having warning signs in place to keep visitors out of dangerous areas, and only 26% \((n = 129)\) of producers had a fire extinguisher while only 21% \((n = 104)\) had a first-aid kit in the sugarhouse.
Sugarhouse Equipment

Once the sap has been collected and processed, an evaporator is used to remove the water from the sap. The average size of evaporator used by Ohio maple syrup producers is a three feet by ten feet (3’ x 10’) unit that is approximately 13 years old. An average 3’ x 10’ evaporator would have an evaporation rate of between 78 to 85 gallons per hour depending on conditions and several variables (e.g. sugar content and atmospheric conditions, etc.) (Leader Evaporator Co., Inc. 1984; Heiligmann and Staats 1996). However, a variety of other equipment was reported to be used as evaporators, including kettles, turkey fryers, or a custom or home-made units. The majority (79%; \( n = 483 \)) of evaporators are fired by wood, while 9% (\( n = 57 \)) are fired by fuel oil, 5% (\( n = 33 \)) by natural gas, 4% (\( n = 23 \)) by propane, 1% (\( n = 5 \)) by steam, and 3% (\( n = 16 \)) by some other technique, such as gasoline or waste oil.

Figure 3.19: Extra amenities found within the sugarhouse.
Flue pans come in many styles and respondents indicated that almost half (44%; \(n = 248\)) have dropped flues in their evaporator. However, 26% (\(n = 148\)) of producers reported raised flues, 24% (\(n = 134\)) reported flat pans without dropped or raised flues, and 7% (\(n = 37\)) did not respond to the question. Almost all producers (95%; \(n = 505\)) indicated they used fire bricks on the arch bottom and side walls. Fewer indicated the use of insulation with just 24% (\(n = 128\)) reporting they use insulation between the pans, 24% (\(n = 127\)) reporting that they have insulated the front pan, 23% (\(n = 122\)) reporting they have insulated the flue pan, and 8% (\(n = 45\)) reporting that they use insulated fire doors.

Many Ohio maple syrup producers (64%; \(n = 410\)) utilize evaporator attachments that are designed to increase production, efficiency, and quality while decreasing labor. The most common attachments are a pre-heater (29%; \(n = 168\)) and steam hood (25%; \(n = 147\)), while only 6% (\(n = 37\)) of producers have a Steam-Away ® unit, 2% (\(n = 9\)) have a Piggy-Back ® unit, and 2% (\(n = 11\)) have an air injection system in the pans. Many producers also indicated they have air tight fire doors (17%; \(n = 97\)), while 22% (\(n = 131\)) reported they had a forced draft/air ventilation system. About 13% (\(n = 73\)) of producers reported having newer automated equipment with an automatic draw-off attachment, and 3% (\(n = 11\)) reported having automatic burner shut-off units (Figure 3.20). Finally, only 5% (\(n = 30\)) of producers indicated they utilized a reverse osmosis system.
Sugarhouse Methods

Almost all producers (96%; \(n = 593\)) indicated they check the density of their syrup for the proper Brix of sugar content, with the majority reporting that they use a hydrometer (80%; \(n = 499\)) to determine syrup density. However, other tools to check density are utilized by producers, including a refractometer (9% (\(n = 56\)), hydrotherm (8%; \(n = 53\)), or the traditional sheeting or scoop method (15%; \(n = 96\)).

Almost all producers reported they filter their syrup prior to packaging. Approximately 16% (\(n = 98\)) of producers indicated using a pressure filtering system with 13% (\(n = 79\)) having a stacked plate filter press and 3% (\(n = 19\)) having a canister style filter. The remaining producers (81%; \(n = 501\)) use a gravity filtering system, 13% (\(n = 63\)) of which reported using the old “traditional” settling tank method (Koelling et al. 1996). The remainder indicated using the following gravity filtering methods.
system methods for filtering: 40% \((n = 147)\) use a single cone; 28% \((n = 102)\) a flat-pan style; and 15% \((n = 55)\) use a double-cone system. Pre-filter paper is the most common type of filter materials \((56\%; n = 244)\) followed by synthetic orlon felt \((43\%; n = 188)\), wool \((33\%; n = 144)\), synthetic polyester \((13\%; n = 57)\), and synthetic rayon filters \((8\%; n = 37)\) (Figure 3.21). However, a variety of other materials were reported as being used to filter syrup, including cotton cloth \((n = 6)\); cheese cloth \((n = 3)\); seed corn sacks \((n = 2)\); paper towels and Kleenex tissues \((n = 2)\); flannel \((n = 2)\); and dairy pipeline milk filters \((n = 1)\).

![Figure 3.21: Type of syrup filtering systems and filtering materials used.]

Blending and Grading Syrup

Approximately 17% \((n = 105)\) of producers reported they blend syrup to adjust the color, density, or flavor of their final product. The most common reason stated for blending syrup was for color adjustment \((56\%; n = 59)\). Other common
reasons for blending syrup included density adjustment (39%; \( n = 41 \)) and blending for flavor adjustment (32%; \( n = 34 \)). Although syrup grading is not required by Ohio law, 36% \( (n = 225) \) of producers currently grade their maple syrup and have been doing so on average for 11 years. Of those producers grading their maple syrup, 73% \( (n = 165) \) indicated using the Vermont Temporary Grading Kit which does not hold its color over time (estimates suggest that these kits hold their color for 2 years) (Vermont Maple Sugar Makers Association, Inc.). Despite this fact, the average age of the Vermont kits used by producers was nine years old with kits ranging from 1 to 35 years old. Only 39% \( (n = 64) \) of kits reported are 2 years old or less while 61% \( (n = 101) \) are older than 2 years (Figure 3.22).

![Figure 3.22: Percent of temporary grade kits past recommended usage.](image-url)
Those producers using a permanent kit predominantly use the official USDA grade kit (9%; \( n = 20 \)); while a smaller number of producers use a Berliner® grade kit (3%; \( n = 6 \)); a Lavabond® grade kit (1%; \( n = 2 \)); or a Hanna® light meter (1%; \( n = 2 \)). Eight percent (\( n = 20 \)) of respondents indicated they used an “other” grading system. These included five producers visually graded from memory while four producers indicated they compared one production run against current and past year’s runs. Additionally, two producers indicated having their own grading scale but did not elaborate, and one producer indicated grading was accomplished from “memory of a kit I saw at the fair years back.”

Marketing and Syrup Sales

The majority of maple syrup producers (68%; \( n = 425 \)) indicated they sell their maple syrup, while 32% (\( n = 195 \)) indicated they do not sell maple syrup or left the question blank. However, later in the survey 82% (\( n = 467 \)) of producers indicated they sell syrup (\( N = 567 \)), 64% (\( n = 395 \)) reporting they sell retail; 23% (\( n = 141 \)) reporting they sell bulk; and 17% (\( n = 107 \)) reporting they sell wholesale (\( N = 620 \)). Only 8% (\( n = 48 \)) of producers indicated that they buy syrup for resale (\( N = 567 \)), and the average amount of maple syrup purchased for resale by Ohio producers is 16,323 gallons. Of those producers indicating they bought bulk syrup for resale, all producers indicated they did so for retail purposes, with an additional 2% (\( n = 14 \)) indicating that they purchased bulk syrup to resell as bulk. The
producers buying extra syrup for resale indicated they purchase most (98%; \( n = 47 \)) from within Ohio. However, a small proportion of producers do purchase maple syrup from other states or provinces, including Pennsylvania, New York, Vermont, Maine, New Hampshire, Quebec, and Ontario (Figure 3.23).

Figure 3.23: Origin of syrup purchased for resale in Ohio.

Historically, prices for maple syrup fluctuate considerably across the state. In 2003, Ohio producers reported that the average price of a retail gallon of medium amber syrup was $30.00 to $32.00. This value is three dollars higher than the reported average price range of both 1999 ($27.00 to $29.00), and 1995 ($27.00 to $29.00), and is between -0.32 and $2.77 higher than the 2003 USDA-NASS average price per gallon at $29.40 (USDA-NASS 2004). Over half (52%; \( n = 297 \)) of producers indicated that they package their syrup in both plain and fancy
glass containers, and 44% ($n = 252$) also use plastic jug containers. Plastic jugs with XL coating are also common containers (31%; $n = 176$), as are metal cans (28%; $n = 160$) (Figure 3.24).

Confections are another product often made and sold by maple producers; but, only 12% ($n = 70$) of Ohio maple producers reported that they converted syrup into maple confections. The top five confections developed by producers include the following: candy (81%; $n = 57$); granulated sugar (31%; $n = 22$); maple spread (29%; $n = 20$); cream cakes (26%; $n = 18$); and, maple-covered nuts (14%; $n = 10$). Other confections produced but by less than 10 producers each include maple popcorn, maple straws, maple jelly, maple sugar bricks, maple suckers, maple barbeque sauce, maple cotton candy, maple fudge, and maple beef jerky.
Advertising and Distribution

Producers indicated that 99% of the distribution of their syrup was within the state of Ohio and only 1% out of state. Only 65% \((n = 371)\) of producers indicated they consume their own maple syrup, and a similar number \((63%; n = 357)\) distributed maple syrup to their friends and family. Producers indicated that the majority of sales \((60%; n = 342)\) occurred at the farm gate or place of residence, with 36% \((n = 204)\) reporting they advertise farm gate sales of their maple syrup. Those choosing to advertise utilized customer mailing lists \((6%; n = 34)\); newspaper advertisements \((4%; n = 25)\); mail orders \((3%; n = 16)\); web page sales \((2%; n = 12)\); radio advertisements \((1%; n = 4)\); and trade publications \((1%; n = 3)\). Producers also indicated they advertised by word of mouth, repeat customers, place of employment, friends and neighbors, and other retail outlets. Other sales were to in-state retailers \((14%; n = 81)\), in-state bulk buyers \((14%; n = 78)\), and local retail outlets, such as county fairs, craft shows, farmers markets \((12%; n = 69)\). Only 1% \((n = 6)\) of producers indicated that sold to out-of-state retailers or out-of-state bulk buyers.

In 2004, a total of 374,724 taps were reported by maple syrup producers, and the average production reported was 1 quart of syrup per tap. When combined, this equates to approximately 93,681 gallons of syrup produced. When sold at the average price reported in 2003 of $27.00 per gallon \((USDA-NASS 2004)\), this suggests that the maple syrup industry provided a total of $2,342,025 of revenue. However, when asked, 41% \((n = 232)\) reported that they produced no income from their maple operation while another 6% \((n = 35)\) left the question blank. Of the
53% \((n = 300)\) of producers indicating a percentage of their annual income derived from sugaring reported the following: 34% \((n = 193)\) indicated 1 to 5% of income was from maple syrup; 11% \((n = 65)\) indicated 6 to 10% of income was from maple production; 5% \((n = 27)\) indicated 11 to 20% of income was from maple production; 1% \((n = 7)\) indicated 21 to 30% of income was from maple production; 0.5% \((n = 3)\) indicated 31 to 40% of income was from maple production; 0.2% \((n = 1)\) indicated 41 to 50% of income was from maple production; 0.7% \((n = 4)\) indicated greater than 50% of income was from maple production.

Of the 13 common types of glass containers, the 8 ounce (236ml) or \(\frac{1}{2}\) pint container was the most used container, and 34% \((n = 52)\) indicted the 8 ounce was the best selling glass container as well \((N = 154)\) (Figure 3.24). Of the seven choices in the plastic container category, the 32 ounce (946ml) or quart container was most used and 53% \((n = 154)\) indicted the 32 ounce was the best selling plastic container. Of the six choices in the metal category, the 128 ounce (3.6 l) or one gallon container was the most used indicated, but the majority \((18%; n = 22)\) indicated the 64 ounce (1/2 gallon) was the best selling metal container (Figure 3.25).
Educational Programs Attended on a Regular Basis

The OSU Extension sponsored workshops “Ohio Maple Days” were the highest attended educational program, with 35% (n = 197) of producers indicating they had attended at least one workshop. Other educational programs attended by producers included local field days (16%; n = 89); hobby producer meeting (8%; n = 46); North American Maple Syrup Council (NAMSC) / International Maple Syrup Institute meetings (3%; n = 19); and other state or province meetings (5%; n = 26).

Sources of Current Information

OSU Extension provides three of the top five sources of information on maple production, as 28% (n = 160) of producers utilize Ohio State personnel and materials (fact sheets and programming). Additional OSU Extension resources

<table>
<thead>
<tr>
<th>Container Size</th>
<th>Syrup Packed per Container Type &amp; Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.35oz</td>
<td>Glass: 10%, Plastic: 20%, Metal: 70%</td>
</tr>
<tr>
<td>3.4oz</td>
<td>Glass: 15%, Plastic: 30%, Metal: 55%</td>
</tr>
<tr>
<td>8oz</td>
<td>Glass: 20%, Plastic: 40%, Metal: 40%</td>
</tr>
<tr>
<td>16oz</td>
<td>Glass: 25%, Plastic: 50%, Metal: 25%</td>
</tr>
<tr>
<td>32oz</td>
<td>Glass: 30%, Plastic: 60%, Metal: 10%</td>
</tr>
<tr>
<td>64oz</td>
<td>Glass: 35%, Plastic: 55%, Metal: 10%</td>
</tr>
<tr>
<td>128oz</td>
<td>Glass: 40%, Plastic: 45%, Metal: 15%</td>
</tr>
</tbody>
</table>

Figure 3.25: Percentages used of the most popular size containers for glass, plastic, and metal containers.
utilized by Ohio maple producers include the *Ohio Maple News* newsletter (23%; \(n = 128\)), and the *North American Maple Syrup Producers Manual* (21%; \(n = 118\)).

Other common sources of information identified were maple equipment dealers (28%; \(n = 159\)); the *Maple Syrup Digest* (the primary international maple publication) (28%; \(n = 157\)); the *Northeast Farming Magazine* (17%; \(n = 96\)); *The Maple News* (15%; \(n = 83\)); “other” States Extension publications (11%; \(n = 63\)); and books (7%; \(n = 39\)); other sources (5%; \(n = 30\)); the internet (3%; \(n = 15\)); and Canadian sources (1%; \(n = 4\)) (Figure 3.26).

![Figure 3.26: Sources of current information used by Ohio maple producers.](image)

Producers' Interests in Further Knowledge and Research

The top five topics receiving the “highest interest” by producers in terms of desiring additional information and training include: 35% (\(n = 192\)) finishing syrup; 34% (\(n = 186\)) threats to the sugarbush; 34% (\(n = 189\)) tapping practices; 32% (\(n = 180\)) sugarbush management; and, 30% (\(n = 165\)) evaporators (Figure 3.27). A
majority of producers were not interested in increased technology (50%; \( n = 257 \)). Only 21% of producers indicated that sap handling was of high interest, and only 24% and 25% of producers were highly interested in learning more about bucket systems and tubing systems, respectively. Most producers indicated at least a moderate interest in most areas (Figure 3.27).

Figure 3.27: Interest in learning more on the following topic areas, arranged by highest interest.
DISCUSSION

The results of this survey suggest that the Ohio maple syrup industry remains a traditional industry with 62% of all taps and 78% of all operations being characterized by bucket collection systems despite the many technological advancements in collection and processing practices. For example, the use of plastic tubing, a reduction in tap size for tree health, and pressure filtering methods for a cleaner product are often not utilized by many of Ohio’s maple producers. One reason for the low adoption rate of newer technologies is that the Ohio maple industry is dominated by small family-owned sugaring operations that are typically passed from one generation to the next.

Characteristics and Educational Needs of the Maple Syrup Industry

In Ohio, the typical sugarbush is 27 acres and is best characterized as a bucket collection operation, gathering sap from 417 taps in galvanized maple buckets and transporting the sap to the sugarhouse in a plastic tank on a trailer pulled by a tractor. With 71% indicating they have trees yet to tap, the industry has room to expand. However, only 47% of producers indicated they have a next generation involved, suggesting that it may be difficult for the industry to expand in the future due to a dwindling labor source.

The fact that bucket collection systems dominate Ohio’s maple syrup industry is not unexpected as almost half of Ohio’s maple producers have less than 250 taps. Of those operations using more advanced tubing collection systems, 75% were in the three largest tap categories (251 to >1,000). Furthermore, the
revelation that 74% of maple producers are still using a traditional 7/16” tap suggests that there is need to educate producers on the benefits of the smaller 5/16” tap. While 43% of tubing operations reported they have converted to the 5/16” tap, only 21% of bucket operations reported that they utilize the smaller, more sustainable 5/16” tap.

Additional educational programming needs to focus on the processing of maple sap, as a significant number of producers are waiting 3 days or longer after collection to process their sap. There also appears to be quality control issues with the cleaning of collection and processing equipment. Only 53% of producers indicated that they clean the sap storage tanks at season’s end and, only 66% clean at season’s start. Likewise, only 59% of tubing operations cleaned at the start and 95% cleaned at the end of the season, while 75% of producers using bucket collection systems clean at the start and 59% clean at the end of the season. Ideally this should be 100% clean at the start and end of the season regardless of the collection system used. Compounding the cleaning issue, only 8% of producers using bucket and tubing operations, respectively, are aware of the proper dilution rate for using bleach as a cleaner. Health concerns including bacterial and mold contamination can be associated with unclean equipment and improper packaging of syrup, as well as significantly decreasing the quality (e.g., color, taste) of the final product (Lawrence, Martin, and Boisvert 1993; Heiligmann and Staats 1996; Koelling et al. 1996).
Another indication that Ohio’s maple syrup industry is a traditional enterprise is that the average producer has a 3’ x 10’ wood fired evaporator that is 13 years old. With only 44% of evaporators having dropped flues and 26% with raised flues, approximately a quarter (24%) of the producers are using a less efficient flat rear pans. Additionally, most of the evaporators used by Ohio producers are not well insulated, yet 95% of producers indicated their evaporators are insulated with fire bricks in the fire box. On average, only 19% reported having insulation in the four critical locations (between the pans, at the flat pan, and the flue pan, or at the fire doors) of the evaporator, and about two-thirds (64%) of producers indicated using other energy or time-saving evaporator attachments to improve efficiency.

The lack of state regulations associated with syrup grading and production inspection is a limitation on enforcing better sanitation standards on the maple syrup industry. Pure maple syrup is valued and judged not only by taste, but by the color and visual appearance (cloudy, floating sediment). Finishing syrup at the proper density and proper filtering are two methods for accomplishing a higher quality product (Koelling and Heiligmann 1996; Hopkins 2002). Almost all of Ohio’s producers indicated they check density of their finished maple syrup, which is a positive trend; however, it is not known whether these hydrometers are accurately calibrated or properly working. Of primary concern are those producers indicating they checked maple syrup density using the antiquated shovel or scoop method (i.e., sheeting). In terms of syrup filtering which is considered a critical step in creating a high-quality finished product (Koelling et al. 1996), 13% of producers continue to use the traditional settling tank method and 3% indicated they did not
filter their final product at all. Removal of naturally occurring sediments and sugar sand are best accomplished through a gravity or pressure filtering system. A majority of producers (81%) use some type of gravity filtering before packaging, and 16% use a modern pressure filtering system to remove sediments, like sugar sand, to polish the syrup. Such practices should be encouraged and techniques demonstrated at future OSU Extension programming.

Finally, there are also indications that the marketing of maple syrup products could be improved. However, the sales information is difficult to interpret as only 68% of producers indicated they sell maple syrup when asked directly. For those indicating they sold their maple syrup products, almost two-thirds (64%) indicated they retail their own product, while 40% reported that they sell their products wholesale or bulk, with almost all sales conducted within the state. The most common types of packaging containers appear to be glass and plastic, although about one quarter of producers indicated that they still use traditional metal cans to package their syrup. The best selling container reported by 82% of respondents was the plastic quart jug. One interesting aspect of the industry in Ohio was that only 65% of producers report consuming their own syrup. Maple Syrup sales from the farm-gate or the home were indicated by 60% of respondents. There also appears to be room for expansion in the market for value-added maple products as only 12% of producers indicated they convert maple syrup into maple confections.
Implications for Ohio State University Extension

Although earlier analyses indicate that producers that attend OSU Extension programming have made beneficial changes in response to lessons learned from Extension programming (see Chapter 2), the results of this survey will assist OSU Extension personnel in directly targeting areas that will improve the sustainability, quality, and productivity of Ohio’s maple resource. Specific areas that this survey have identified that can be of use to OSU Extension programming include sustainable practices associated with the sugarbush, quality control measures (such as cleaning equipment and grading syrup), and marketing strategies. The fact that producers ranked OSU Extension programming efforts as three of the top five sources of information they seek out to stay current within the maple industry, suggests that OSU Extension has played and will continue to play a major role in improving the sustainability and productivity of the maple syrup industry in the state.
LITERATURE CITED


Ohio Administrative Code. 2004. Mandatory food sampling tolerance level standards and action steps for maple syrup, sorghum, and honey. OAC 901:3-44-01, OAC 901:3-45-01 to 901:3-46-09.


CHAPTER 4

Association Among Demographic Characteristics and Production Practices in the Ohio Maple Syrup Industry

ABSTRACT

Maple syrup production contributes $2.5 million annually to Ohio’s economy and provides a supplemental income to forest land-owners. Despite over 90 years of service by Ohio State University (OSU) Extension, little information is available concerning the Ohio maple syrup industry. The primary aim of this research was to investigate the association among production factors and demographic characteristics of the Ohio maple syrup industry and examine the influence of OSU Extension programming on the industry. In 2004, a detailed survey was sent to all known Ohio maple syrup producers ($N = 761$) with the goal of elucidating relationships among production factors and demographic characteristics. Eighty-one percent ($n = 620$) of the surveys were returned by active maple syrup operations. Specific industry characteristics examined were producer heritage (Amish, non-Amish or English), producer age, sap collection methods (bucket or tubing), attendance at OSU Extension educational programming, and the size of the sugaring operation based on total number of taps. Chi-square analyses reveal that there are important differences among demographic groups ($\alpha = 0.05$).
For example, Amish producers in the state have significantly larger sugaring operations, utilize bucket collection systems rather than more advanced tubing systems, and are younger than their English counterparts. Amish producers are also less likely to attend OSU Extension programming than their fellow English producers, while those older English producers with large operations and tubing systems were more likely to attend. Results of this research will enable educators to develop programming to increase outreach and engagement efforts to currently underserved sectors of the Ohio maple syrup industry.

INTRODUCTION

Although Ohio’s economy is dominated by technological and agricultural sectors, forestry-related products including maple syrup are important components. Maple syrup production contributes approximately $2.5 million dollars annually to the state’s economy, and the sale of maple syrup products provides a supplemental income for many Ohio families (USDA-NASS 1992-2004). Since 1992 the United States Department of Agriculture, National Agricultural Statistical Service (USDA-NASS) has tracked maple syrup production in Ohio. Over the past twelve years, Ohio ranks as the fifth largest maple syrup producing state behind Vermont, Maine, New York, and Wisconsin, with approximately 400,000 taps producing 75,000 gallons a year at an average price of $30.46 per gallon (USDA-NASS 1992-2004).

In order to serve this important clientele, the Ohio Agricultural Research and Development Center (OARDC) and Ohio State University Extension (OSU Extension) have conducted research, education, and outreach programs designed to improve
maple syrup production and marketing for over 90 years. Since the 1940s, OSU Extension has also sponsored annual workshops across the maple-producing portions of the state that highlight technological advancements in sugarbush and sugarhouse management known as the Ohio Maple Days. However, little is known about collection and production methods, marketing, and demographics of producers and consumers of Ohio’s maple syrup industry. While USDA-NASS has surveyed limited aspects of Ohio’s maple industry, a complete assessment of the maple industry in Ohio has not been attempted despite the important contributions the industry provides to the state’s economy. For one, necessary resources were not available to complete the assessment, and two, maple producers are a reclusive and independent group concerned with protecting the privacy of their cash-based supplemental income (Lawrence, Martin, and Boisvert 1993; Demchik et al. 2000).

Our previous work (see Chapter 3) has shown that the average producer in the state is a second-generation, 53 year-old male. Additionally, approximately 25% of maple syrup producers in the state are Amish while the remaining 75% of producers are non-Amish (or English). Our analyses also shows that the average Ohio sugaring operation has 604 taps, although there is a wide range of operation sizes with the smallest reporting only 4 taps and the largest 6,500 taps (see Chapter 3). In terms of sap collection methods, 78% of all Ohio sugaring operations utilize bucket systems and only 22% utilize more advanced tubing collection systems. Finally, our previous surveys of maple syrup producers demonstrate the importance of OSU Extension programming to maple syrup producers in the state as
82% of the 2004 Ohio Maple Days participants indicated they primarily relied on Ohio Maple Days workshops to learn about current maple practices and technology (Chapter 2).

Despite this important baseline industry data, little is known about the specific factors influencing the maple syrup industry in Ohio. In an effort to better understand how demographic and operation factors influence maple syrup production, and examine how these relationships might affect OSU Extension maple syrup programming, we examine patterns associated with demographic and production characteristics of maple syrup producers in Ohio. Specifically, we: 1) examine the association among producer age, sap collection method used, cultural heritage of the producer, and producer participation in the Ohio Maple Days workshops; 2) determine how these characteristics are association with sugaring operation size; and, 3) consider the implications these results have on the maple industry in Ohio and how these results can guide future OSU Extension educational programming and materials.

METHODS

Maple Producer Survey

We compiled a master survey list of maple producers from an OSU Extension database and private sources working within the industry. In May 2004, producers on this master list (N = 1,050) were mailed a multi-sectional questionnaire designed following the methods outlined in Dillman (2000). The 84-question instrument followed maple sugar production through sap collection method (bucket
or tubing); sugarbush & sugarhouse characteristics; specifics on equipment use; syrup grading and blending practices; syrup and sugar marketing methods; and detailed demographic characteristics. The final section was on educational resources respondents used and their perspective on what were the important educational program needs for the maple syrup industry of the state. The flow, language, and questions were designed to reduce intrusiveness and increase return rates. All mailings were sent with return postage, instructions, and cover letters to encourage response rates. A copy of the questionnaire can be viewed at http://snr.osu.edu/research/goebel/web/2004%20OHMapleSurvey.pdf.

After the initial survey and two reminder notices had been mailed, all those not responding to the first questionnaire were sent a second identical questionnaire (n = 703). For those producers not responding to the second questionnaire, a third shortened questionnaire was sent to all non-respondents (n = 377), with 26% (n = 100) being sent by priority mail. Follow-up phone calls were not utilized as suggested by Dillman (2000) because of a significant Amish producer population that would not have been reached using this method. An overall response rate of 81% (N = 620) was achieved. The initial mail list (N = 1,050) had 289 blank, no longer or never produced maple syrup questionnaires removed for a master list of 761 maple producers. Of the total of 620 questionnaires returned from active maple operations, 78% (n = 485) are first questionnaire responders; 13% (n = 82) are second questionnaire responders, and the 9% (n = 53) are third round responders.
Data Analysis

We focused our analyses on five categories of information obtained from the questionnaire that are believed to be important factors influencing the maple syrup industry (see Chapter 3): producer heritage (English, Amish); sap collection methods (buckets, tubing); producer age compared to average age of producers (less than 53 years old, equal to or greater than 53 years old); attendance at the OSU Extension sponsored “Ohio Maple Days” educational workshops (attend, do not attend); and sugaring operation or production size based on number of taps. Producers were placed into one of five categories (Table 4.1) based on operation size (e.g., number of taps). Using the total number of taps, we estimated the producer’s production potential (gallons of syrup) using the state average of one quart syrup per tap as indicated by questionnaire respondents.

<table>
<thead>
<tr>
<th>Classification Category</th>
<th>Number of Taps</th>
<th>Projected Production*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hobby</td>
<td>&lt; 100</td>
<td>25 gal</td>
</tr>
<tr>
<td>Small Retail-Wholesale</td>
<td>101 – 250</td>
<td>25 – 63 gal</td>
</tr>
<tr>
<td>Medium Retail-Wholesale</td>
<td>251 – 500</td>
<td>63 – 125 gal</td>
</tr>
<tr>
<td>Large Retail-Wholesale</td>
<td>501 – 1,000</td>
<td>125 – 250 gal</td>
</tr>
<tr>
<td>Commercial</td>
<td>&gt; 1,000</td>
<td>&gt; 250 gal</td>
</tr>
</tbody>
</table>

* Using State average of 1 quart of syrup per tap

Table 4.1: Ohio sugaring operation size classification categories.
We used chi-square analyses to determine if significant relationships exist among heritage, sap collection methods, attendance to the Ohio Maple Days workshops, and average producer age (\(\alpha = 0.05\)). Additionally, using chi-square analysis these four variables were examined to determine if a significant relationship existed with sugaring operation size. Finally, we examined the relationships among producers using a chi-square independence test and comparing those producers with \(\leq 250\) taps (hobby and small retail-wholesale producers) to those with \(> 250\) taps (medium retail-wholesale, large retail-wholesale and commercial producers). This analysis was conducted to aid in describing differences or similarities between smaller and larger producers. All chi-square analyses were conducted using MINITAB® software (Minitab 2003).

RESULTS

Cultural Heritage and Age

Chi-square analysis showed a significant association between heritage and average producer age. Amish producers are likely to be younger than their English counterparts when compared to the average age of Ohio maple producers \((\chi^2 (1, N = 610) = 16.9, P = < 0.001; \text{Figure 4.1})\). Only 32.9\% of Amish respondents are above the average producer age of 53 years, while 52.4\% of the English respondents are above the average producer age (Figure 4.1).
Sap Collection Methods

There was a significant association between heritage of maple syrup producers and sap collection methods. More English producers tend to have tubing collection systems than their Amish counterparts \((X^2(1, N = 620) = 4.4, P = 0.031;\) Figure 4.2.A) with 23.8% of English respondents having adopted tubing sap collection systems and only 15.7% of the Amish respondents collecting sap with tubing systems (Figure 4.2.A)
Chi-square analysis, however, showed no significant association between sap collection method and producer age ($X^2 (1, N = 610) = 1.9, P = 0.169$, Figure 4.2.B). Seventy-six percent of producers <53 years old and 80.8% of producers ≥53 years old indicated they use buckets for sap collection, while 23.8% of producers <53 years of age and 19.2% of producers ≥53 years of age collect sap with tubing systems (Figure 4.2.B).
Ohio Maple Days Workshop Attendance

Chi-square analysis revealed significant associations between attendees in the Ohio Maple Days workshops and producer heritage, age, and sap collection methods. English producers are more likely to attend the educational workshops than their Amish counterparts ($X^2 (1, N = 620) = 11.0, P = 0.001$; Figure 4.3.A) as only 21% of Amish respondents participated in the Ohio Maple Days workshops, while 35% of the English respondents reported they attend the educational workshops (Figure 4.3.A). In terms of producer age, producers $\geq 53$ years old were more likely to attend the workshops than their younger counterparts ($X^2 (1, N = 610) = 9.2, P = 0.002$; Figure 4.3.B). Only 26.6% of respondents below the average producer age ($< 53$ years of age) attended the workshops, while 38.1% of respondents greater than the average producer age ($\geq 53$ years of age) attended the educational workshops (Figure 4.3.B). Finally, chi-square analysis showed a significant association among attendees in the Ohio Maple Days educational programming and the producers sap collection method. Producers with tubing collection systems were more likely to attend than producers utilizing bucket collection systems ($X^2 (1, N = 620) = 29.8, P = < 0.001$; Figure 4.3.C). Specifically, only 26.4% of respondents with bucket collection systems attended the Ohio Maple Days workshops, while 51.1% of respondents with tubing collection systems attended the educational programming (Figure 4.3.C).
Figure 4.3: Association between attending the Ohio Maple Days workshops to respondent’s heritage (A), age (B), and sap collection methods (C).
Operation Size

We observed a significant association between operation size and cultural heritage, with Amish producers more likely to have larger sugaring operations in terms of number of taps than their English counterparts ($X^2 (4, N = 620) = 48.6, P < 0.001$; Figure 4.4.A). Of those producers responding to the survey, 80% of the Amish operations are classified within the three larger size categories (>251 to >1,000; Table 4.1), while only 51% of English respondents operations are found in the three larger size classification categories (Figure 4.4.A). However, no significant association between sugaring operation size and producer age was found ($X^2 (4, N = 610) = 4.6, P = 0.330$; Figure 4.4.B) as 58.9% of producers <53 years of age and 56.7% of producers ≥53 years of age were associated with the larger sugaring operations with more than 250 taps (Figure 4.4.B).

When we compared sugaring operation size and sap collection method using chi-square analysis, we found sugaring operations using tubing systems are more likely to be in the three larger size classification categories (Table 4.1) ($X^2 (4, N = 620) = 46.6, P < 0.001$; Figure 4.4.C). Only 52.8% of bucket collection operations were associated with the larger size categories (> 250 taps), while 75.5% of tubing collection operations were associated with the three larger size operation classifications (Figure 4.4.C).

Finally, when we compared operation size with attendance to the Ohio Maple Days workshops, we observed that producers from larger operations (251 to >1,000 taps) are more likely to attend the educational programming than producers from smaller size (<250 taps) operations ($X^2 (4, N = 620) = 30.2, P < 0.001$; Figure 4.4.D).
Only 31.5% of producers in the smaller size categories (hobby and small retail-wholesale) attend the Ohio Maple Days workshops, while 68.5% of producers within the larger size categories (medium retail-wholesale, large retail-wholesale, and commercial) attend the educational programming conducted by OSU Extension (Figure 4.4.D).

Figure 4.4: Association of operation size (number of taps) with producer heritage (A), age (B), sap collection method (C), and attendance in the Ohio Maple Days educational programming (D).
DISCUSSION

Producing maple syrup is a labor intensive enterprise and because most maple syrup operations in Ohio are family-oriented enterprises, it involves many members of an extended family, multiple families, friends, and in some instances neighbors. This fact is represented in our data as the average producer in Ohio is a 53 year-old, male, second-generation producer. Additionally, almost half (47%) of the producers indicated that a next generation was involved in their operation. Our results showed no association between a maple producer’s age and sap collection method or size (number of taps) of the sugaring operation. We did, however, find significant relationships among other demographic and production characteristics (Table 4.2).

<table>
<thead>
<tr>
<th>Cultural Heritage</th>
<th>Producer Age</th>
<th>Operation Size</th>
<th>Sap Collection Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producer Age</td>
<td>English - Older</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Operation Size</td>
<td>Amish - Larger</td>
<td>Not Significant</td>
<td>--</td>
</tr>
<tr>
<td>Collection Method</td>
<td>English - Tubing</td>
<td>Not Significant</td>
<td>Larger - Tubing</td>
</tr>
<tr>
<td>Attendance to Ohio Maple Days</td>
<td>English – More likely</td>
<td>Older – More likely</td>
<td>Larger – More likely</td>
</tr>
</tbody>
</table>

Table 4.2: Ohio maple syrup industry analysis summary.
Our analyses showed that Amish tend to be younger than their English counterparts. Additionally, we found that Amish tend to have larger operations (251 to >1,000 taps), use buckets for sap collection, and are less likely to attend the Ohio Maple Days workshops. While there may be many reasons for these relationships, there are cultural aspects that can help explain these patterns. The Amish population in Ohio has increased from 5 communities in the early 1900s to over 41 communities in 2003 for a total population of 52,000, making 33 of 88 Ohio counties home to 30% of all known Amish (Donnermeyer 2004). The result is generally large families and close-knit church networks that can help support less efficient and more traditional maple syrup collection and production practices, such as the use of bucket collection systems.

Amish also believe in separation from the world and that hardship in life is part of their eternal salvation and a factor that helps maintain community harmony (Schreiber 1962; Moore, et al. 1999). This belief requires them to separate themselves from most non-Amish social, religious, and political activities. This separation also discourages participation with educational and government assistance programs (Stinner, et al. 1989; Donnermeyer 1997). For example, two of the three annual Ohio Maple Days workshops are held in highly concentrated Amish communities so as to be within buggy travel distance, yet a low percentage of the total Amish maple producing population actually attend the workshops. These results suggest that OSU Extension programming (e.g. field days) may need to be coordinated with sugaring operations within Amish communities or church districts. Additional outreach activities may also be necessary, including sharing
information in other formats (e.g. newsletters, newspapers, Amish based publications), and the distribution of fact sheets to current Amish participants for distribution to other producers in their communities and church districts.

In terms of collection systems, our results show that both Amish and English producers would benefit from additional educational programming related to the latest technological advances to help improve efficiency. As mentioned earlier, 78% of all Ohio sugaring operations utilize bucket systems while only 22% currently have more efficient tubing collection systems. The average bucket operation has 417 taps, with 13% of the 620 operations surveyed having > 1,000 taps. Of the 80 producers that are considered large commercial operations (>1,000 taps), about one-third are operated by Amish producers (n = 33). As properly constructed and maintained tubing collection systems have been shown to increase production (Walters 1982; Coons et al. 1987; Heiligmann et al. 1996) and benefit sugarbush health (Coons et al. 1987; Houston, Allen, and Lachance 1989; Heiligmann et al. 1996), the use of tubing collection systems may be important production measure that needs to be addressed by OSU Extension as it serves the maple industry. Specifically, Extension programming may need to focus more on the benefits of tubing in regards to sugarbush health, reduced labor requirements, and increased production potential within the context of existing cultural and economic barriers.

Finally, our results indicate that the size of an operation and age of producer is an important determinant of participation in educational programming, such as the Ohio Maple Days workshops. Producers with larger (>250 taps) tubing collection operation are more likely to attend. English producers are more likely to
attend. However, there is still a large component of maple syrup producers (both Amish and English) that do not participate in educational programming. Our analysis shows that our educational programming is reaching the larger operations (>250 taps) which represent approximately 90% of the taps in the state (Figure 4.5). However, this only represents 54% of the producer population, suggesting that we need to target our educational programs to this clientele (Figure 4.5).

Figure 4.5: Proportion of taps and producers reached through current Ohio Maple Days workshops.
While there may be many reasons we have not been successful reaching these smaller producers (≤ 250 taps) there are two likely explanations. First, maple sugaring in Ohio is a part-time business and producers do not take time off work to attend; and second, most producers are protective of their privacy and do not want anyone, especially a group associated with the state or federal government, to know the scope of their cash-based business with typically a non- or under-reported supplemental income. Increasing participation among these producers will be difficult.
LITERATURE CITED


Kugler, Dan. 2004. Cooperative state research, education, and Extension service, within natural resources and the environment.


Ohio Administrative Code. 2004. Mandatory food sampling tolerance level standards and action steps for maple syrup, sorghum, and honey. OAC 901:3-44-01, OAC 901:3-45-01 to 901:3-46-09.


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